SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GEORGE BROWN GOODE.

GEORGE BROWN GOODE was born in New Albany, Indiana, on the thirteenth of February, 1851, and died at Washington, D. C., on the sixth of September, 1896. His illness was brief; on Thursday pneumonia developed, and he died on Sunday evening. His wife, three sons and a daughter are left.

Goode was interested in natural history as a boy, and during his college course at Wesleyan University found opportunity to occupy himself both with zoology and with museum methods. After graduating from the University, in 1870, he devoted himself to these subjects, making a collecting trip to the West Indies in 1872 and 1873. In the latter year, at the wish of his friend, Prof. Baird, he became connected with the Smithsonian Institution, to which his genius, as a man of science and an administrator, was devoted for twenty-three years.

We hope to give later an adequate account of Goode's contributions to ichthyology and to museum administration. His extended series of volumes on 'The Game Fishes of the United States,' 'The Fisheries and Fishing Industries of the United States,' 'American Fishes' and 'Oceanic Ichthyology' are standard works, showing great scientific knowledge and originality and power of expression and arrangement. But few men could have accomplished so much even in a long life devoted exclusively to

scientific research. His published works on 'Plan of Classification for the World's Columbian Exposition,' 'Museums of the Future' and other contributions to museum methods and the history of scientific and educational institutions made him the leading authority in America on these subjects. His executive work in the Smithsonian Institution and the U. S. National Museum, extending to every detail and label, will only be appreciated by those who have been associated with him.

It is fitting that we should refer to his connection with this JOURNAL. For him it was only one of many interests, but the JOURNAL had scarcely another friend so able and wise. He contributed an important paper, his address as President before the Philosophical Society of Washington, to the first issue of the new series, and in the last number that appeared before his death his last paper was printed. He not only published in SCIENCE many articles of great value but he also helped continually in its editorial conduct. This JOURNAL, like the Smithsonian Institution, the National Academy of Sciences and other agencies devoted to the advancement and diffusion of science, has suffered an irreparable loss.

But Goode's greatest work was the man himself. He was honored and loved by all. His untiring and unselfish devotion to his work and to the helping of others ended only when he had sacrificed his life to it. A man such as Dana dies, his life work accomplished, and we do not rebel against the order of the world. But when nature, prodigal of life and souls, spends millions of years to bring forth at the end a man such as Goode, and then cuts him down in his prime, we stand at gaze. Each must take up his appointed task, but more wearily.

BOTANICAL SOCIETY OF AMERICA.

THE second annual meeting of the Botanical Society of America, was held at Buffalo, N. Y., on August 21 and 22, 1896, in rooms in the High School building, kindly provided for its use by the Local Committee of the A. A. A. S. Business sessions were held on Friday afternoon, Saturday morning, and for a few minutes late Saturday afternoon. The reading of papers occupied the greater part of Saturday afternoon, and the address of the retiring president was given on Friday evening. Sessions of the Council preceded the business sessions of the Society for which it arranges the program.

The Society was called to order by President WILLIAM TRELEASE, who resigned the chair to the president-elect, CHARLES E. BESSEY, which he assumed with a brief address.

The Secretary announced that since the last meeting one of the most distinguished members of the Society, MICHAEL SCHUCK BEBB, had passed away. A committee consisting of Messrs. COULTER, BRITTON and MACMILLAN, was appointed to prepare suitable resolutions. These, presented later and adopted, are as follows :

"The Botanical Society of America desires to place upon record an expression of esteem for its deceased member, Michael Schuck Bebb, who died December 5, 1895, at San Bernardino, California.

"His published studies upon the difficult genus Salix have brought him to high rank as a professional botanist, and American botany owes to him a debt of gratitude as one of its most distinguished representatives."

The ballots for officers for the coming year, which are mailed to the secretary, when canvassed by the council, showed the

election of JOHN M. COULTER, of the University of Chicago, as president; CHARLES R. BARNES, of the University of Wisconsin, as secretary; ARTHUR HOLLICK, of Columbia University, as treasurer; and B. L. ROBINSON, of Harvard University, as councillor. No election having occurred of vice-president and a councillor, the Society proceeded to elect these officers. CHARLES S. SARGENT, of the Arnold Arboretum, was elected vice-president, and F. V. COVILLE, of the Department of Agriculture, councillor.

The council having approved the names of CHARLES H. PECK, State Botanist of New York, and BEVERLY T. GALLOWAY, Chief of the Division of Vegetable Physiology and Pathology, Department of Agriculture, these gentlemen were unanimously elected to membership.

The Society having asked the council to consider the best means of increasing the membership of the Society while preserving rigidly the high standard required by the constitution, the council recommended the appointment of a committee whose duty it should be to see that suitable nominations were made, so that the making of nominations would not go by default as heretofore. With the distinct statement that the making of nominations to membership by this committee shall in no way prevent the making of such nominations by other members, Messrs. Trelease, Atkinson and N. L. Britton were appointed.

Special invitations to the Society to hold its next meeting in Detroit, Denver and Nashville, were read and left with the council for action. Much time was given to the consideration of the question of a winter meeting. After a full expression of the opinions of members had been obtained, the matter was left in the hands of the Council with instructions to determine the feasibility of such a meeting and to appoint it if found practicable.

The Treasurer's report, which was audited and found correct by a committee composed of Messrs. Underwood and MacMillan and Mrs. Britton, showed a balance of about $700, deposited chiefly in the Institution for the Savings of Merchants' Clerks, in New York. The Council directed that the Treasurer give bond for $1,000 in any surety company, the expense for the same to be paid by the Society.

The request of the National Educational Association, that a member be appointed to confer with a committee of that association regarding the unification of requirements in botany for entrance to colleges, was acceded to by designating President Bessey to act as such conferee.

On Friday evening the address of the retiring president, William Trelease, to which the public was invited, was given in the chapel of the High School. A good audience listened to the discussion of 'Botanical Opportunity.' By request of the Society the address is published in full in SCIENCE and in the *Botanical Gazette*. The suggestiveness and timeliness of the address is such that the Council directed that 1,000 separates of it be distributed in the name of the Society.

On Saturday afternoon the following papers were read before the Society:

L. H. BAILEY: *The philosophy of species-making.* 15 min.

GEORGE F. ATKINSON: *Some problems in sporophyll transformation.* 20 min.

CONWAY MACMILLAN: *Some characteristics of a fresh-water insular flora.* 1 hour.

N. L. BRITTON: *A species of Eleocharis new to North America.* 5 min.

CHARLES R. BARNES,
Secretary.

BOTANICAL OPPORTUNITY.*

IN selecting a subject for the first presidential address before the Botanical Society

*Address of the retiring President, delivered before the Botanical Society of America, at Buffalo, N. Y., August 21, 1896.

of America, which you have done me the honor of requiring of me, I have deviated somewhat from the customary lines of such addresses, inasmuch as I have not attempted to present an abstract of recent general progress in botany, nor any results of my own investigation. Such topics, indeed, are more likely than the one I have chosen to interest an assemblage of specialists like this Society, but as the Society is supposed to have as a principal object the promotion of research, the present has seemed to me a fitting occasion to address, through the Society, the large and growing number of young botanists who may be expected to look to this Society for a certain amount of help and inspiration in the upbuilding of their own scientific careers; hence it comes that I have selected as my subject 'Opportunity.'

Let us for a moment compare the conditions under which scientific work is done to-day with those prevalent in the past. From a purely utilitarian, and, for a time, perhaps, almost instinctive knowledge of plants and their properties, beginning, it may be, before our race can be said to have had a history, through the pedantry of the Middle Ages with their ponderous tomes, botany, almost within our own memory, stands as the scientific diversion or pastime of men whose serious business in life was of a very different nature. Such training as the earlier botanists had was obtained as being primarily useful in other pursuits than pure research, though there is abundant evidence that the master often enjoined upon the pupil the possibilities of botanical study, and no doubt he stretched the limits of botanical instruction deemed necessary, just as is done to-day in technical schools, in the hope that the surplus might be so used as to increase the general store of knowledge; but, at best, training was limited and research was recreation and relaxation.

But our predecessors, even the generation immediately before us, lived under conditions which made it possible for a man to hold high place in the business or professional world, to accumulate wealth in commerce, and at the same time to devote much time to the study of nature. To-day the man who is not entirely a business man is better out of business, and, with few exceptions, the man who is not entirely a student is little better than a dilettante in science. Concentration is the order of the day, and specialization is the lot of most men. But specialization, the keynote of progressive evolution, is always intimately associated with a division of labor. Fortunately, the men who enter and win in the great game of commerce and manufacture see in a more or less clear way that nearly every great manufacturing or commercial advance has grown out of a succession of obscure discoveries made by the devotee to pure science, often considered by him, indeed, only as so many more words deciphered in the great and mysterious unread book of Nature, but sooner or later adapted and applied for the benefit of all men by the shrewd mind of a master in the art of money-making. To these men, successful in business, we owe it that to-day not only are some men able to devote their entire time to scientific research and the propagation of knowledge, but that their work is done under favorable conditions, and with a wealth of aids and adjuncts that would hardly have been thought of a generation ago.

Instead of a smattering of systematic botany and organography, given as an adjunct to chemistry, medicine or engineering, the student who wishes may to-day equip himself for a life of research in botany, by a considerable amount of preparatory work in the lower schools, beginning, perhaps, even in the kindergarten, and by devoting the larger part of his un-

dergraduate time in college to the elements of the subject in its broadest, and, if he wish, technical scope, having the benefit of marvelously detailed appliances and a broad knowledge of general facts. If he can and will work for a higher university degree, thus equipped, he may delve into the depths of the most limited specialty, guided for a time for those who have already broken soil there, and left at last with a rich and unexplored vein for his own elaboration. With this training, if he be fortunate in securing a position offering opportunity for research, or if he enjoy independent means, he may hope for a life-time of more or less uninterrupted opportunity for unearthing the wealth of discovery that lies just within his reach.

Considering the prevalent conditions, my subject naturally divides itself into two quite distinct parts: the opportunity of institutions and of individuals. We stand to-day, apparently, at a transition point. Most of the active workers of the present time are college professors, who have done the research work that has made their names known, during the leisure that could be found in the year's routine of instruction or during their long vacations, and with facilities nominally secured for class use, or, in many instances, like those of a generation ago, the private property of the investigator. Even when appreciated at something like its true value, their original work, for the most part, has been closely watched to prevent it from encroaching upon the first duty, class work; and in most cases the facilities that they have been able to bring together are in direct proportion to the number of students attracted to their departments, and, therefore, in inverse ratio to their own leisure for research. But, as I have already stated, the feeling is growing among men able to foster such enterprises that research is a thing worthy of being promoted, and we have before our eyes the spectacle of a gradually unfolding class of institutions in which investigation is not only tolerated but expected, either as an adjunct to instruction, as in the greater number of colleges, as a concomitant of educational displays, as in botanical museums and gardens, or, at least nominally, as a basis for technical or economic research, as in several of the larger drug houses, and, notably, in various agricultural experiment stations and the National Department of Agriculture. Perhaps the time has not yet come when laboratories of botanical research can stand out quite alone and justify their existence without reference to other ends, the utility of which is more generally understood and conceded, but it seems safe to predict that the next decade will see their complete evolution.

Opportunity, for institutions, lies primarily in equipment, and secondarily in its use. The problem of equipment for research is a complicated and difficult one. So long as there were no laboratories specially designed for this purpose it was natural that the instructional laboratory should be furnished with appliances for demonstration, and that these should be amplified, as far as possible, for the repetition of experiments, in the first place, and afterwards for their extension; and it is no doubt true that a number of the smaller educational laboratories are to-day over-equipped when account is taken of the possible use to which they can be put. With a specialization such as we now see in progress, it may be questioned whether the ordinary collegiate equipment cannot be reduced in scope in many instances, with benefit to the institution, by releasing money often badly needed in other directions, either in the same or different departments. On the other hand, it is certain that the equipment of the broader research laboratories, whether connected with universities or independent, must be made much more comprehensive

than any which to-day exists in this country.

Under the stimulus of the last two decades, botany has come to the front in most colleges as a study well calculated to develop the powers of observation and the reasoning faculties. Where it still occupies the place of a fixed study of a few terms' duration in a prescribed undergraduate course, it is evident that the necessary equipment of a department is expressible in the simplest terms—for each course, that which is needed to exemplify by the most direct object lessons the subject selected, and enough general and collateral material and literature to complement the work. But the case is somewhat different when, as is now frequent, a considerable option is allowed the student in the courses taken for the baccalaureate degree. Here the temptation exists to secure equipment for the broadest possible series of electives, and it is too often yielded to for the best interests of the institution. However liberal one may be in the matter of electives, it is evident, in most instances, that the student cannot afford to devote more than about one-half of his undergraduate time to a single study like botany, and in this time he can cover only a definite amount of ground. While there is a certain seductiveness in the perusal of long lists of electives in a college catalogue, the serious contemplation of them shows that few, if any, students can hope to take all of the courses of such a list, and as, for the most part, they are garnished out in an attractive form, there is likely to be embarrassment in the wealth of subjects, so that, if left to himself, the student is very likely to select a series of disconnected but pleasing fragments, rather than the proper links in an educational chain. Experience shows the wisdom of limiting the list of electives to those that there is reasonable probability that the student can take, and of making the list a consistent whole, fairly opening up the entire field of botany in such manner as to pave the way for a piece of advanced thesis work at the end, and for specialization after graduation. So far as undergraduate instruction is concerned, where, as is usually the case, funds are limited, it is here desirable, as in the other instance, to limit the scope of the departmental equipment quite closely to the requirements of the courses offered. As the senior thesis work is almost certain to be a further study of some one of the subjects already elected, the provision for it, in nearly every instance, is easily and quickly effected by a comparatively inexpensive addition, in each case, to the standard library and laboratory equipment. Such research work as the head of the department and his assistants find time for, as well as such post-graduate work as may be undertaken, can then be provided for in the same manner, piece by piece, with the exception of the final touches, demanding the use of the larger reference libraries or collections, the provision for which is not likely to be far to seek in the strongest research centers within a very few years.

Great herbaria, broad reference libraries, and large stores of apparatus and living or preserved material, are possible only to few universities and to the still fewer institutions specially endowed for research, to which alone, indeed, they seem strictly appropriate. For the latter, every shade of breadth of foundation is possible, from the laboratory and library limited to the narrowest specialty, to the institution founded and equipped for research in any branch of pure or applied botany. Fairly perfect equipment of the former class it is possible to find here and there, to-day, but though the seed is sown in several places, the broadest institutions, in their entirety, are still to be developed.

No doubt the first requisite in any such in-

stitution is a library of scope comparable with its own. Whatever may be said against the prevalent nomenclature discussions, it must be admitted that they are having the effect of bringing to the front the half-forgotten work of many of our predecessors, some of which, at least, is well worthy of resurrection, and, incidentally, this is stocking our larger libraries with a class of books which have confessedly been too much neglected of late. Without for a moment losing sight of the fact that botany is a study of one branch of Nature—an object study—we must recognize that its prosecution beyond the merest elements is not only greatly promoted by but almost dependent upon a knowledge of what has already been done.

Where an institution is located in a literary or scientific center, closely associated with large general libraries, learned bodies and the like, it is usually relieved of the necessity for purchasing and keeping up the long files of such serial publications as the journals, proceedings of societies, etc., of mixed contents, which prove expensive alike in cost, binding and space, which for a given subject are used but seldom, and which, nevertheless, are the most valuable part of a large reference library, since they are hardest to duplicate. But where a botanical institution stands in absolute or comparative isolation it must carry this burden in addition to that of maintaining a library of treatises on botany alone. And, moreover, no sooner is research begun in any direction than the necessity of following up divergent threads running in many directions becomes evident; for so close and complex are the interrelations between things in organic nature, that no single subject can be pursued far without drawing in others at first sight having no possible bearing on it. After the serials, which from their expensiveness can be possessed by only the larger libraries, stand undoubtedly the general classics in the several subdivisions of botany, followed by the more restricted memoirs, and among these, for convenience of use, should be found, whenever possible, separates and reprints from the journals and series of proceedings, even when the latter are complete on the shelves.

Next to books, material preserving records, or available for study, forms the great foundation in any research institution. A generation ago, or even less, this expression would have been taken as synonymous with an herbarium, perhaps associated with a garden of greater or less extent; but to-day the most comprehensive of museum possibilities must be added, so greatly has the subject broadened and increased its needs. For a broadly-planned institution, with ample means, no doubt the scope of the herbarium should be as great as that of the library, comprising every group of plants, representing a wide range of geographical distribution, the effects of cultivation, etc.; and, however limited they may be at first, such museum accessories as alcoholic material, large wood and fruit specimens, and sections for microscopic study, are sure to accumulate quite as rapidly as they can be cared for suitably, and to prove in time a very important part of the equipment. Though some of the best botanical work has been performed entirely in the herbarium, there has long been a growing conviction that for certain groups of plants, even for purposes of description and classification, field observation is absolutely necessary, while it is self-evident that for all studies of biology living material is essential. Side by side with the herbarium, then, and virtually as a part of the same general collection, stands the experimental garden, with its greenhouses and other appliances.

While many of the most useful studies are made with but few aids beyond the library and collections referred to, there is a

large class of subjects, now being closely followed by some of the keenest investigators, which demand a special instrumental equipment. However it may be with library and collections, there seems little doubt that, as a rule, apparatus should be obtained only as it is needed for direct use. Except for the rotting of the bindings observed in the libraries of manufacturing cities, and where illuminating gas is used, books, when once classified and indexed, are easily and cheaply kept in a usable manner. If a few simple rules are followed, herbarium material is also preserved safely for generations at a very small cost; and even sections, and specimens in fluid if properly preserved in the first place, may be kept for many years without great deterioration. Instruments designed for research, as a general thing, represent a considerable sum of money, since, excepting microscopes, microtomes and balances, they are rarely made in numbers allowing any great economy in the labor of manufacture. Each of them is also, unfortunately, with few exceptions, calculated for a restricted class of experiments and likely soon to be greatly modified. Apparatus, moreover, is usually of a delicacy of adjustment calling for the greatest care in handling it and the most perfect protection possible against rusting, etc., so that, as a general thing, a case of instruments ten years old is merely a historical curiosity, in part entirely out of date and for the rest so badly out of order as to be nearly or quite useless. Except for a few standard instruments, I think it is now generally recognized that this part of the facilities, however costly it may be, should be regarded as transient, perishable material, rather than a permanent equipment. The history of the most successful physiological laboratories—in which delicate apparatus is chiefly used—furthermore shows that the most important results, as a rule, are not obtained by the use of commercial instruments, but by simple apparatus designed by the investigator to meet the precise needs of the problem with which he is busied, and usually constructed by him or his laboratory mechanic at very little cost.

Although it seems comparatively easy to decide on the proper limits of library, herbarium and instrumental equipment for a given institution, knowing its scope, situation and resources, it is very difficult to arrive at as satisfactory a conclusion concerning the extent of the research garden. As a general thing, such gardens are also intended to be useful in college work, or to afford pleasure and instruction to the public, so that they are likely to be heterogeneous, almost of necessity, and usually they are made far too comprehensive. More than any other class of facilities, garden plants require constant and expensive attention if they are to be kept in usable condition; and with all of the care that can be given them, they are forever performing the most inexplicable and unexpected gyrations with their labels, so that the collections grown in botanical gardens (because of their variety) are notoriously ill-named, though it would naturally be supposed that they, of all collections, would be above suspicion in this respect.

My object being to speak of facilities for research, rather than education or entertainment, I ought to pass by this part of the subject with a mere mention; but I can hardly dismiss it without comment. Where the only object is to supplement the facilities for undergraduate work, the scope of a garden can be very small or moderately large, according to the courses it is to help elucidate. It may be confined to what may be called a propagating bed for plants needed in quantity, either in season or out of season, for class use, to an exemplification of the natural affinities of plants, or to various other instructive synopses, representing medicinal plants, fibre plants, forage plants,

fruits, vegetables, timber trees, nut trees, shade trees, carnivorous plants, climbing plants, the sleep of plants, pollination, dissemination, etc., or it may be devoted to several of these combined. If it is to be a pleasure ground as well, not only should the art of the landscape architect be invoked in the arrangement of the plants, but it is necessary to add collections of decorative shrubbery and a large variety of purely ornamental florists' forms of herbaceous plants. If research is added to its aims, the collection must be further augmented by specially selected groups cultivated from time to time as needed for study.

Unfortunately, few, if any, gardens are so richly endowed that they can cover, in a satisfactory manner, the entire field indicated, or even any large part of it. From what has been said of the peculiar difficulties pertaining to the maintenance of botanical gardens, it is evident that in no other line of facilities, whether for pure research or not, is a wise restriction so necessary as here. Once properly prepared, a species is represented in the herbarium on one or more sheets of paper safely and economically stored away in a pigeon hole; but in the garden it is a constant source of care and expense so long as it lasts. Hence it is possible for one of the larger herbaria to contain representatives of more than half of the 200,000 species, more or less, of phanerogams, and a considerable, if smaller, proportion of cryptogams, while it is absolutely impossible for anything like this number to be represented in a living state in the best garden. No doubt the local requirements of every institution will do more to influence the exact scope of its living collections than any theoretical considerations, but it is certain that in most cases the greatest usefulness combined with the minimum expenditure will be reached by adapting the synopses chosen to the chief aims of the institution, as closely as possible, and very rigidly restricting the species cultivated to the smallest number capable of adequately expressing the facts to be shown. Perhaps it is safe to say that an institution able to maintain a herbarium of half a million specimens, representing one-fifth as many species, is doing exceedingly well, if it has in cultivation at any one time 10,000 species of the higher plants; and there are very few gardens which actually grow half of this number, while no inconsiderable percentage of the plants cultivated are so deformed, distorted, dwarfed, and imperfect, as a general thing, that they can scarcely be said to represent the species whose name they bear, either in appearance or technical characters.

This leads to the conclusion that not only class gardens, but research gardens, should be kept within reasonably narrow bounds, so far as permanent planting is concerned, while allowing sufficient elasticity for rapid and ample temporary expansion in certain directions along which work is planned. This does not necessarily mean that any considerable amount of land not used in the permanent plantation need be reserved for special expansion. As a rule, the more important gardens are situated in or near large cities, and the high price of land alone would prevent such reservation in most instances; but the impure atmosphere of many of the larger cities is a further and even a stronger reason for selecting, for any large experimental undertakings, a suitably located and oriented tract of farming land, easily rented for one or several years at a relatively low figure. Granting the wisdom of such temporary adjuncts to a research garden, a step further leads to a recognition of the possibility of securing the most varied climatic conditions by establishing branch gardens located where particular kinds of study can best be carried on. In no other way can gardens be made to contribute to the fullest extent

to the study of marine or seaside plants, alpines, or the great class of succulents, etc., characteristic of the arid regions of our Southwestern States and Territories, and in no other way, except in the field, can these groups be studied satisfactorily, even from the standpoint of the classificatory botanist.

Undoubtedly, too, the research institution of the future will count as a part of its legitimate equipment, the provision, as needed, of very liberal opportunities for its staff to visit even distant regions for the study, in their native homes, of plants which cannot be cultivated even in special gardens in such a manner as to be fully representative.

If the entire equipment here sketched in outline is not only appropriate, but essential to the great centers of botanical investigation that are making their appearance as results of the specialization and division of labor that are now manifesting themselves in the endowment of research, it by no means follows that every institution, even of this class, should try to develop from the start on all of the lines which, intertwined, compose the complex tissue of botany. With ample means, the ideal development is that which from the beginning recognizes all branches as of value, and classifies and develops them alike in proportion to their relative importance. But to secure the greatest return for the money expended, it is desirable to equip fairly well before increasing the force of salaried men much beyond what is needed for the care and arrangement of the material accumulating. This principle, if followed out, almost forces an over-development in the branches of special interest to the earlier employees—a departure from the ideal symmetry which is sure to be justified by the performance of more work in these hypertrophied specialties, with reference to the sum invested, than in other directions. From this may also be drawn the seemingly just inference that where the means are limited it is far better to concentrate the entire equipment on the specialties of the persons who can use it than to allow them to work at a disadvantage through an effort, however commendable it may at first appear, to secure a symmetrical equipment.

With the evolution of centers of pure research will appear new problems. Just as the attendance of a large number of students in the botanical department of a college has heretofore been found to justify the acquisition of facilities beyond the power of their immediate use, it will be found that where research institutions exist in close connection with a university of recognized standing, their equipment will be utilized more or less fully in postgraduate work done toward the acquisition of the Doctor's degree, so that, like the undergraduate equipment, it will be more or less satisfactorily accounted for by the number of candidates for such degree; but with broadly grounded and well endowed research institutions not so situated, it is inevitable that as they take permanent form on the lines calculated to make them available for advanced research in any line of botany, they will sooner or later come to represent a very large sum of invested money, of which only a part is usefully employed at any given time, the remainder being held as a necessary but temporarily unproductive reserve. The same thing is seen, to a certain extent, in all large libraries and museums; but, unlike the general library, of interest to the entire reading public, or the collection of historical or political works, referred to by many people of ordinary intellectual attainments, the advanced equipment in botany, for the most part, is useful and interesting only to botanists, so that, while it may possess a passing interest for the general student, its

serious use is limited to a very restricted class. How to increase this use to the maximum may well demand our best thought.

No doubt, just as many colleges now offer scholarships, making their advantages available to men who otherwise could not enjoy them, and some of our universities offer fellowships, opening their own post-graduate courses or those of foreign universities to deserving students, the evolution of research institutions will witness some such provision for enabling students who have partially completed pieces of research work to visit and utilize these centers without encroaching too far on the limited savings from the small salaries which, as a rule, are drawn by the botanists of the country. After all, however, the great opportunity of attainment, for such institutions, whether or not connected with colleges or universities, lies in the performance of research work by their own employees; and while, except in the few instances already referred to, and notably in the National Department of Agriculture, to-day there is some hesitancy in recognizing the employment of a staff of investigators as a legitimate part of the maintenance expense of an establishment which does not use a large part of their time in instruction or necessary curator's routine, it is quite certain that within a very few years opinion will have so changed that a considerable number of salaried positions for research work in pure or applied botany will exist; and as these positions will compete with the professorships in the best universities, it seems probable that the salaries pertaining to them will be approximately those paid by the larger colleges.

In addition to bringing together facilities for research and rendering them easily accessible to competent investigators, and maintaining their own corps of workers, engaged in such study, institutions of research have no small field of usefulness opened up as publishers of the results of the work they have promoted. I shall have occasion later to speak of the means of publication from the standpoint of the student who is seeking to bring out his work in the best form; but it also demands consideration from the point of view of the institution. Much difficulty is experienced in looking up the literature of a subject because of the large number of journals, etc., in which references must be sought, and it is probable that at some time or other most workers have impatiently wished that publication could be confined to one or a few channels. Simple as this would render the bibliography of botany, it is obviously impossible; and the amount of work deserving or demanding publication is so great and so rapidly increasing as to leave no doubt that means of effecting the latter must be considerably augmented. To publish the results of good work well is no less commendable or helpful than to facilitate or perform such work. Nor is it less appropriate to an institution such as I have in mind. The object of publication being the adequate preservation and diffusion of a record of the results of research, however, it is easily seen that harm may be done by injudicious or ill-considered publication. While a volume of homogeneous contents may be so published almost anywhere as to accomplish its purpose, a serial publication ought to be started only when there is reasonable probability that it will persist for a considerable length of time. Granting this probability, a research institution with adequate funds forms one of the most satisfactory and effective agencies of publication, since it can place its proceedings or reports in all of the principal libraries of the world, a thing which the journals do not always accomplish; and not only can it thus amplify its field legitimately, but almost of neces-

sity it must assume the duty of publication if it is to accomplish the greatest results possible from its direct investigation.

One has only to pass a short time in the library of one of the larger scientific institutions to be convinced that a great deal of activity is manifested in the botanical world. Each month and each week brings many additions to the literature of the science, and so numerous, varied and widely scattered are these contributions that one feels the greatest hesitancy in publishing on even the most restricted subject, lest others should have antedated his discoveries. Yet, notwithstanding the variety and number of botanical publications, and the great progress which is undeniably made every year, it is a matter of frequent comment that the progress made is by no means so much greater than that of our predecessors as might be expected, considering the greater advantages under which work is prosecuted to-day. While it must be borne in mind that the seizing of the general features of a landscape is far easier than the working out of its detailed topography, that the outlining of the field of botany or of its principal divisions could not fail to proceed more rapidly, even under unfavorable conditions, than the elaboration of the details of the many specialties into which it is now broken up, so that less prompt and voluminous results are naturally to be expected now than a generation ago, there is reason to question whether the present returns cannot be increased. How to secure the greatest possible results from the large number of trained men and of men holding or soon to hold salaried positions, and from the large equipment in laboratories, libraries, herbaria and gardens, is a subject deserving of the most careful study, whether viewed from the standpoint of the endower or administrator of an institution of education or research, or from that of the botanist whose reputation is built up in the performance of the duties assigned to him in such an institution.

While there is every reason to expect large returns from the endowment of such independent departments of research, freedom from the duties of the class room, while leaving more time available for investigation, will not prove an unmixed blessing. I believe it to be the experience of the best investigators in this country that research is promoted by the necessity of imparting some or all of its results in the class room. In no other way, after specializing to the small field in which it seems necessary for most of us to confine ourselves, can one make sure of preserving the breadth of view needed for the investigation of even a limited specialty in the most successful manner. It must be admitted further that the power of application and concentration varies with different men, so that up to a certain point the interruptions introduced by limited teaching or looking after collections in many cases may give fresh zest to the pursuit of knowledge in the time remaining for research. And it may be that at this very point lies the greatest difficulty to be met and surmounted in the development and management of research institutions.

Though there is no doubt that some supervision and pressure are conducive to the performance of the greatest possible amount of investigation, as of other work, since they insure consistent planning and close application, it cannot be overlooked that this is the extent to which scientific work can profitably be crowded. To require more of an investigator than that he shall be reasonably busy with thoughtfully planned study is and has always been antagonistic to the performance of his best work; and the requirement of some institutions that a bulletin shall emanate from each department at stated intervals, while

it insures quantity in publication, generally does so at the expense of quality of attainment. As a rule, genius, which, left to itself, now and then leaps to the most unexpected accomplishments, is most effectively repressed by close supervision. It is tolerant of guidance, but not of the goad; and yet, on the whole, perhaps, both guided and driven, if this is done wisely, it accomplishes most, for in harness it becomes plodding research, which is dull, to be sure, but if persevering, productive of cumulative results which become of incalculable importance. In fact, whether fortunately or unfortunately I shall not attempt to say, the world has come to recognize the slow, but sure progress of research as in the main more desirable than the irregular and intermittent leaps of genius, though the two are closely akin—patient labor over endless facts on the one hand, and broad observation and untrammeled thought on the other.

If, everything considered, it is slow and persistent investigation, rather than sudden inspiration, to which we must look for the accomplishment of the greatest collective results in botany, it is equally true that the individual student is more likely to build his reputation on the summation of the small accomplishments of many days of close application than to arrive at some great discovery by a leap—and this quite aside from the fact that the latter result is entirely impossible to many a man who in the other way may still hope to be of great utility. It has been said that there is a tide in the affairs of men, which, taken at the flood, leads on to fortune, and no doubt what is true in the military, literary and commercial world is equally true in the smaller realm of science. In fact, I fancy that each member of my audience has in mind some one preëminent occasion which may have looked small or large at the moment, but the seizing or neglect of which he now sees marked a turning point in his scientific career. But, it will be seen, it is not of the one great opportunity that I would now speak. Improving it always has marked and always will mark the turning point of life, but unfortunately the bridge cannot be crossed before it is reached, and great as the value of a true and wise friend's counsel then is, it cannot be replaced by any generalities in advance; therefore it is to the countless lesser opportunities, repeated with almost every day that dawns for us, that I turn, in the hope that something helpful may be said of them, and in the firm belief that in them lies the making of any intelligent and indefatigable young man.

To the investigator, breadth of foundation is even more necessary than to the institution founded for his use, for while the latter should endure for centuries, and may be remodeled and improved at any time, he is limited to a single lifetime and can rarely in mid-life or later repair the deficiencies of ill-advised or defective training. Not only should his powers of observation be well developed, but he should be given more discipline in reasoning than is now customary—though the botanists of a generation ago counted among their number several men who are even more widely known as philosophers.

Equipped for the work, and enabled to use the material facilities that others have brought together against the day of his need, much depends on an early and wise formulation of the investigator's plans. Except for the tasks set by a teacher, and really long contemplated by him and carried out by his intelligence, if through the eyes and hands of pupils, few pieces of valuable research are taken up on the spur of the moment, without previous thought on the part of the investigator. They are usually the outgrowth of reflection started, perhaps, by some casual observation or the remark of another, and turning and return-

ing until it ultimately shapes itself into a definite plan. Simple as it may be in theory, few things are more difficult in practice than the formation and inception in early life, inexperienced, and often without certainty of the power of continuance for any length of time, of a plan for a single piece of research work worthy of the devotion of a lifetime; and few and fortunate are the men, even among those who have outlined and entered upon such a task, who are not forced from the path by side issues, or whose lives are not unduly short. More commonly one must be content to choose several smaller subjects, for their own sakes somewhat closely related to one another, if possible, and to follow these up in succession. It is surprising how blind even the sharpest-eyed among us are to all that does not directly interest us, and it is an equal surprise to see how quickly one's eyes open to things which he has once begun to think of and look for. If for no other reason than this, I would again urge breadth of early training, as giving the first impulse to many a series of special observations to be followed up in later life.

Once a subject is chosen, observations accumulate with surprising rapidity, and next to the selection of a subject nothing is so important as system in pursuing it. If we do not see it in ourselves, each one of us can see in others a great waste of energy, resulting from shiftless and ill-considered methods of procedure, by which the mind is so distracted and the memory so overloaded with unessentials and dissociated fragments that those which belong together are not matched, nor the missing bits, in plain view, gathered. How often do we have to return, time after time, and review partial work that we have had to dismiss temporarily from the mind, in which, meantime, has been lost the connection between the completed portion and the continuation awaiting our leisure. A phenomenal memory may enable one to work in this disjointed fashion without the production of scrappy results or the review of all that has been done each time that the task is resumed ; but for those not so gifted, order and method are absolutely necessary, and next to a clear idea of the end aimed at, I should place the immediate making of full and exact notes as their most essential part. Some years since I was privileged to assist Dr. Gray in collecting and republishing the botanical writings of Dr. Engelmann, and it was a matter of surprise to us both, as it has been to others, to see how voluminous these were. Had Dr. Engelmann devoted his entire life to botany, they would have been as creditable in quantity as in quality, but for the leisure-hour productions of a busy professional man, they were truly marvelous. Some years later, when, his herbarium and library having found a resting place at the botanical garden in the development of which he had felt an interest for many years, it fell to my lot to arrange in form for permanent preservation Dr. Engelmann's manuscript notes, sketches, etc., I was far more surprised at the extent of these than I had been on collecting his printed works, for when mounted and bound they form sixty large volumes. In addition to their intrinsic value, these are of more than usual interest as showing the methodical manner in which Dr. Engelmann worked. On his table seems to have been always a bundle of plants awaiting study. As each specimen was examined, its salient features were noted and sketched on the back of an ever-ready prescription blank. When interrupted, he laid his unfinished sketch away with the specimen, to resume his observation and complete his study at the first opportunity, without any doubt as to what had been seen in the first instance. And so from individual to variety, from variety to species, from species to genus, and from

genus to family, his observations were preserved in memoranda that facilitated the resumption of interrupted work at any time and after any lapse of time. In no other way could the odd moments between the daily calls and occupations of a busy physician have contributed so much to botanical knowledge. In no other way could his seemingly small opportunity for investigation have been converted into a great one.

Almost as important as the early selection of a worthy subject for study and the adoption of a method insuring the preservation and use of even the most trivial information bearing on it, is the adoption of suitable library methods. The student whose specialty is small and little explored has mainly the task of observing and reasoning from the facts before him; but in the departments that have long been the subject of study, while a part of the work is already done to his hand, and the prospect is that he can go much further than on entirely new ground, the task of ascertaining and profiting by what his predecessors have done is often a difficult one. Not infrequently the literature of a subject is so scattered as to make it next to impossible to pass it all in review, and at best the task of finding the fragments is one calling for a special faculty. One or more attempts have been made to form general bureaus of scientific information, to which one need only turn if he would be possessed of references to the principal literature of any subject in which he chanced to be interested. Perhaps, as library facilities accumulate at the great centers of research, some method may be found of supplementing them with the skill of expert librarians who shall be able and willing to carry the contents of the library, at least in skeleton form, to those who cannot come to it; but the time has hardly yet come when any American library is complete enough in all branches to offer this aid with a reasonable chance of doing what it promises, or so manned as to make such assistance possible except at the sacrifice of more valuable direct research.

For the present, then, the investigator must be content to do his own delving into the literature of his predecessors. Fortunately, much of the earlier literature has been sought out by some of the writers on any branch that has been the subject of earlier study, so that, starting with a memoir of recent date, one is guided to others, each of which may bring further references, until, if he have access to the works, almost the entire earlier literature is unearthed. On the other hand, the most recent literature of a subject is always the most difficult to find and use. After a study has been gotten well under way, so that the student is keenly alert to every observation or published item in any way bearing on it, if he have access to a library receiving the principal current journals, he is not likely to overlook any important publication on his specialty which then appears. As a rule, all of the larger papers, at least, are noticed in *Just's Jahresbericht*, generally not more than a year later than that for which the volume purports to be compiled; but as the *Jahresbericht* is always some three years in arrears, it is difficult to prevent notes extending over a period of this duration from being defective, at least for the earlier part of the time, and there is, at present, no means of removing this difficulty, though the plan proposed to zoologists a year ago, and, I presume, tested during the present season, if successful, would be equally applicable to botany.

So far as the final result is concerned, perhaps the manner in which one's work is published is almost as important as the subject selected or the method adopted for its investigation. Alphonse De Candolle, in one of the most helpful treatises ever published in the hope of rendering botani-

cal work methodical and productive,* lays a great deal of stress on the early selection of a form of publication for the results of each important study. This done, the work continually shapes itself to this end. Frequently there is much difficulty in securing the publication of a monograph or memoir in precisely the form and place desired by the author, but there is seldom an insuperable obstacle in the way of publishing any really meritorious work in about the manner wished, provided it is suitably prepared.

In general, it is desirable that works of a given class should be so published that, in seeking one, a reader is likely to learn of another. This appears less important for books than for shorter papers, since the arrangement of independently issued volumes in a library, and the fact that they are catalogued by authors, render it relatively easy to learn of and have access to them; but even here one finds no little convenience in the recognition that a book by a given author on a given subject is quite likely to be listed in the catalogue of a certain publishing house. Smaller papers, which are usually published in the proceedings of some society, or in a scientific journal, may almost be said to be made or ruined by the place selected for their publication. Probably as library facilities increase and are more thoroughly classified and subject-indexed, this will become less true than it now is, though the underlying reason for it will remain. Usually a reader turns to the popular journals only when looking for popularized science, and is not likely to seek the original results of research there, so that such papers are nearly or quite lost for a long time if published in these journals. As research has now become specialized, the journals devoted to the publication of its results have gradually fallen into line as special journals. Except where they are chiefly devoted to digests and abstracts, few nominally general journals now exist which do not lean so strongly toward a specialty that one unconsciously classes them with it, notwithstanding the extraneous matter that they contain. While nothing once published is ever absolutely lost, all of this extraneous matter is likely to be overlooked by the persons most interested in the subjects considered. No small part of the present confusion and strife in botanical nomenclature arises from the comparatively recent unearthing of descriptions and names of plants published in such improbable or inaccessible places as to have escaped the attention of those whom they might have helped most, to be brought to light at a later date as great mischief makers. From now on, then, it may be concluded that a decreasing number of special papers are likely to be published in general journals, which will become more and more popular or bibliographic in their nature, with the exception that the necessarily slow differentiation of learned societies into special sections will for a long time cause the proceedings of many of the older to continue of the most miscellaneous character. Where papers are lengthy, though not adapted to publication in book form, such proceedings virtually offer the only means of printing them, and except by the comparatively few botanists who enjoy the privilege of membership in purely botanical societies with publishing facilities, they must be accepted for the present, notwithstanding the attendant disadvantages. Shorter papers, however, can usually find room in the journals, and except in cases where they possess a temporary and exceptional value for the columns of a popular or general journal, or one devoted to another subject to which in some manner they are relevant, they are best published in a periodical devoted exclusively to botany, and

* La Phytographie, ou l'art de décrire les végétaux considérés sous différents points de vue. Paris, 1880.

in most cases in one devoted as closely as may be to their particular branch of botany, provided it have a fair general circulation, and especially provided it reach the principal botanical libraries.

Especially in the earlier years of their work writers are sometimes given to distributing their papers among a number of journals. Except for the purpose of specialization just referred to, this is usually a mistake. Knowledge that a certain student has published on a given subject is often first obtained through incidental reference, lacking every element of precision. The probability that all of his writings are to be found in one or a few journals or series of proceedings greatly simplifies the completion and use of such references, since the *Royal Society's Catalogue*, though perhaps more complete as to titles, is necessarily even farther behind than the *Jahresbericht*. Where the subject of an earlier paper is again passed in review by the author, only the gravest necessity should lead to the selection of a new medium for the publication of the later paper.

Whether the medium of publication selected or accepted be a journal or the proceedings of a society, the possibility of having separates struck off for the mere cost of press work, paper and stitching, makes it possible for almost any paper to appear as an independent pamphlet, accredited, to be sure, to the journal from which it is an excerpt, but, like a book, necessitating author's citation in catalogues, and admitting of more ready arrangement in its proper place where the works of a library are disposed on the shelves according to subject. The time was when a pamphlet was considered of little value and quite certain not to be preserved, but one of the characteristics of the modern librarian is a great and growing appreciation of the value of this class of works, leading to their careful preservation.

No small part of the volume of M. De Candolle, already referred to, is devoted to very explicit and well considered directions for preparing the record of one's observations for the press; and the general conclusion is reached, after a careful analysis of the subject, that the maximum value of any manuscript exists at the exact moment of its completion, indicating this as the most suitable time for its publication. Though it is probable that the publishing of any important work should not be unnecessarily delayed after it has been pushed to what the author considers completion—at least so far as he can carry it,—there may be reasons in some cases for publishing a preliminary statement considerably in advance of the completion of the work. Neglecting the publication of an early abstract of unfinished work as a means of securing priority—too often a purely personal matter—I may say that such abstracts, coupled with a request for material or data, not infrequently bring to the advanced student the means of greatly increasing the completeness and value of his work.

Time does not permit me to go into a detailed analysis of the many ways in which an investigator may use his time so as to make it productive of important results for himself and others. Having passed in somewhat comprehensive, though hasty, review, the main factors in the question, I desire, in closing, to repeat that for most of us the opportunity of life does not lie in a great and abrupt change of condition, but that it is composed of countless minor chances which are great only when viewed collectively. To see and use them calls for alert senses, a knowledge and use of the means of ascertaining what has already been done, and, by exclusion, something of what remains to be done, facilities adequate to the task in each case, and indomitable perseverance and ceaseless activity. Great as the value of facilities is, they are merely means to an end. They accomplish noth-

ing themselves. Hence, though it is certain that the most voluminous and, perhaps, the most comprehensive results, and those resulting from the performance of coherent experiments extending through a long series of years, will come from the great centers of research, there is no reason why qualitative results equal to the best may not continue to come, as they have in the past, from isolated workers, to the rounding out and completion of whose studies the facilities of the larger institutions will be more and more applicable as the problems of equipment are worked out.

WILLIAM TRELEASE.

BOTANICAL GARDEN OF MISSOURI.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION E.—GEOLOGY AND GEOGRAPHY.

SECTION E of the American Association this year virtually included the Geological Society of America. The latter organization held only a short meeting for routine business on the Saturday evening previous to the meeting of the American Association, and referred all its papers to Section E of the A. A. A. S. The total number of papers offered in Section E was 42. The last day of the meeting the Section was divided into two subsections, one dealing with Pleistocene Geology, and the other taking the remainder of the field of the science. Even with this division, the time did not suffice for the full reading of all the papers, and a considerable number of papers whose authors were absent were read by title. While none of the papers recorded any discoveries of epoch-making significance, nearly all of them contained the results of solid and valuable work, contributing, in an important degree, to the advancement of science.

The following is a list of the papers presented:—

Notes on the Artesian Well sunk at Key West, Florida, in 1895. By EDMUND OTIS HOVEY.

The Hydraulic Gradient of the Main Artesian Basin of the Northwest. By J. E. TODD.

The true Tuff-beds of the Trias, and the mud enclosures, the underrolling, and the basic pitchstone of the Triassic Traps. By B. K. EMERSON.

Volcanic Ash from the North Shore of Lake Superior. By N. H. WINCHELL and U. S. GRANT.

The "Augen-gneiss," Pegmatite Veins, and Diorite Dikes at Bedford, Westchester Co., N. Y. By LEA MCI. LUQUER and HEINRICH RIES.

The Tyringham (Mass.) "Mortise Rock," and Pseudomorphs of Quartz after Albite. By B K. EMERSON.

The Succession of the Fossil Faunas in the Hamilton group at Eighteen Mile Creek, N. Y. By AMADEUS W. GRABAU.

Development of the Physiography of California; Synopsis of California Stratigraphy. By JAMES PERRIN SMITH.

Ancient and Modern Sharks, and the Evolution of the Class. By E. W. CLAYPOLE.

Observations on the Dorsal Shields in the Dinichthyids. By CHARLES R. EASTMAN.

The Discovery of a new Fish Fauna, from the Devonian Rocks of Western New York. By F. K. MIXER.

Interglacial change of course, with gorge erosion, of the St. Croix River, in Minnesota and Wisconsin; The Cuyahoga Preglacial Gorge in Cleveland, Ohio. By WARREN UPHAM.

A Revision of the Moraines of Minnesota. By J. E. TODD.

Notes on certain Fossil Plants from the Carboniferous of Iowa. By THOMAS H. MACBRIDE.

Origin of the High Terrace Deposits of the Monongahela River. By I. C. WHITE.

The making of Mammoth Cave. By HORACE C. HOVEY.

The Colossal Cavern. By HORACE C. HOVEY.

James Hall, Founder of American Stratigraphic Geology. By W J MCGEE.

Professor Hall and the Survey of the Fourth District. By JOHN M. CLARKE.

Sheetflood Erosion. By W J MCGEE.

Glacial Flood Deposits in the Chenango Valley. By ALBERT P. BRIGHAM.

Origin of Conglomerates. By T. C. HOPKINS.

Origin of Topographic Features in North Carolina. By COLLIER COBB.

The Cretaceous Clay Marl Exposure at Cliffwood, N. J. By ARTHUR HOLLICK.

Post-Cretaceous Grade-Plains in Southern New England. By F. P. GULLIVER.

The Algonquin River. By G. K. GILBERT.

The Whirlpool-Saint David's Channel. By G. K. GILBERT.

Profile of the bed of the Niagara in its Gorge. By G. K. GILBERT.
The Niagara Falls Gorge. By GEORGE W. HOLLEY.
Origin and Age of the Laurentian Lakes and of Niagara Falls. By WARREN UPHAM.
Correlation of Warren Beaches with Moraines and Outlets in Southeastern Michigan. By F. B. TAYLOR.
Notes on the Glacial Succession in Eastern Michigan. By F. B. TAYLOR.
The Operations of the Geological Survey of the State of New York. By JAMES HALL.
The Eocene Stages of Georgia. By GILBERT D. HARRIS.
The Origin and Age of the Gypsum Deposits of Kansas. By G. P. GRIMSLEY.
Geomorphic Notes on Norway. By J. W. SPENCER.
The Slopes of the Drowned Antillean Valleys. By J. W. SPENCER.
Notes on Kansan Drift in Pennsylvania. By E. H. WILLIAMS.
Preliminary Notes on the Columbian Deposits of the Susquehanna. By H. B. BASHORE.
Pre-Cambrian Base-leveling in the Northwestern States. By C. W. HALL.

The address of the Vice-President, Prof. B. K. Emerson, has been published in full in this JOURNAL, and requires, therefore, only brief reference here. It was a remarkably bright and interesting address, and was listened to with delight by a large audience.

Two sessions of the Section were occasions of especial interest, dependent in one case upon the time, and in the other upon the place, of the meeting. The former of these sessions, occurring on Wednesday afternoon, was devoted chiefly to exercises in commemoration of the sixtieth anniversary of Prof. James Hall's work on the Geological Survey of the State of New York. It is, indeed, a fact well worthy of commemoration, that the great geologist who is now at the head of the New York Survey, has completed a period of sixty years of continuous service, and still possesses a physical and mental vigor which promises years of fruitful work in the future. In some respects, the survey of the State of New York has been of more importance in the history of American geology than that of any other part of the country. The remarkably complete exhibition of the Paleozoic strata in that state, the relatively early date of the commencement of their study, and the sagacity with which the true principles of stratigraphical classification were conceived by Prof. Hall and his associates, have made the State of New York the standard of comparison in the study of Paleozoic formations for the whole region of North America east of the Cordillera. The work of Prof. Hall holds, therefore, a relation to the stratigraphical geology of North America somewhat similar to that which the work of William Smith in England holds to the general stratigraphical geology of the world. The New York Survey has a special interest for the members of the American Association, by reason of the fact that the Association of American Geologists, first organized by the State Geologists of New York and a few other states, was the germ which developed into the American Association for the Advancement of Science. The exercises were introduced by Vice-President Emerson in a brief and appropriate address. Prof. Joseph Le Conte, President of the Geological Society of America, spoke in behalf of that Society with rare eloquence. Prof. Hall responded gratefully to the congratulations of his fellow geologists. The papers by W J McGee and John M. Clarke, in which was given an appreciative history of Prof. Hall's work, were worthy of their theme. A letter of congratulation was read from Dr. George M. Dawson, Director of the Geological Survey of Canada; and appropriate remarks were made by a number of gentlemen who, in various ways, had been associated with Prof. Hall and his work. The meeting, as a whole, was an appropriate and worthy commemoration of an epoch-making work.

The other occasion of especial interest

was the meeting of the sub-section of Pleistocene Geology on Friday afternoon, when the papers were read relating to the history of Niagara Falls. Mr. Gilbert's three papers were of extraordinary interest. In the paper on the Algonquin River, evidence was given of an outlet of Lake Algonquin, heading at Kirkfield, Ontario, and following the Trent River to Lake Ontario. This outlet for the drainage of the upper lakes belonged to an earlier date than the outlet through Lake Nipissing and the Ottawa River. There is, therefore, evidence of two epochs, after the birth of the Niagara River, in which it lost the waters of the upper lakes, and was reduced to the condition of an outlet merely for the Erie basin. In the paper on the Profile of the Bed of Niagara in its Gorge, evidence was given to show the correlation between these epochs of low water and the excavation of particular parts of the gorge. In the swifter and more turbulent parts of the Niagara, a determination of the depth by sounding is, of course, impracticable; but an approximate estimate of the depth has been reached indirectly by determining the velocity of the water, since obviously the same volume of water must pass in a unit of time through every cross section of the gorge. The Niagara gorge shows two stretches of narrow and shallow channel, in which the current is swift and tumultuous, one extending from the railroad bridges to the Whirlpool, the other extending for some distance below Foster Flats. The latter was apparently excavated during the low-water epoch in which the drainage of the upper lakes was through the Algonquin River, while the former is correlated with the later epoch in which the upper lakes discharged their waters by way of Lake Nipissing and the Ottawa River. In the discussion of Mr. Gilbert's papers, Mr. F. B. Taylor gave important confirmation of the views advanced in regard to the history of Niagara, derived from his investigations upon the history of the lakes.

In his paper on the Whirlpool-St. David's Channel, Mr. Gilbert presented evidence for the belief that that channel was excavated in preglacial times to a depth below the present level of the Niagara River. The outcrops of rock in Bowman's Creek were explained as due to the fact that Bowman's Creek is not in the middle, but at one side, of the ancient preglacial channel. The evidence of a deep, continuous channel between the Whirlpool and St. David's is acknowledged to be incomplete, since none of the wells in that region are in the line of the middle of the channel, and none of them, therefore, reveal its full depth.

In the discussion of this paper, Prof. I. C. White suggested that at moderate expense an experimental boring could be made in the direct line between the Whirlpool and St. David's, and the question of the existence of a deep channel in that vicinity conclusively settled. The suggestion was favorably received, and a committee, consisting of Prof. White and Messrs. Gilbert and Spencer, was appointed to carry out the proposed investigation. Subscriptions of twenty-five dollars each towards the expense of the investigation were made by Prof. White, Prof. H. S. Williams, and Mr. F. B. Taylor.

Besides the papers relating to Niagara, a number of other interesting papers relating to Pleistocene Geology were presented. Mr. F. B. Taylor, in his paper on the Glacial Succession in Eastern Michigan, described a series of fifteen terminal moraines between Cincinnati and the Straits of Mackinaw, and pointed out interesting correlations between the Quaternary history of Michigan and that of western New York.

Mr. Warren Upham, in his paper on the St. Croix River, gave evidence that in preglacial times the upper St. Croix River left

the present St. Croix valley near the mouth of the Sunrise River, and emptied into the Mississippi between Anoka and Minneapolis, while the lower St. Croix Valley was occupied only by the waters of the Apple River. The intermediate portion of the present St. Croix River, including the picturesque gorges called the Dalles, is attributed to the Aftonian and Wisconsin stages of the Glacial period. In his paper on the Cuyahoga Preglacial Gorge, Mr. Upham presented evidence that that valley was deeper than had been indicated by facts previously known, new reports of wells giving a depth of 350 to 470 feet below the surface of Lake Erie.

Prof. J. E. Todd gave an interesting review of the Moraines in Minnesota. These moraines were mapped by Mr. Upham as extending east and west in nearly straight lines without regard to the topography of the country. Such a position seems *a priori* improbable; and, according to Prof. Todd's observations, the morainic accumulations may be considered as forming a series of concentric curves around lobes of the ice sheet.

Prof. I. C. White, in his paper on the High Terrace Deposits of the Monongahela River, attributed them to a Monongahela Lake, made by the ice sheet damming up the Monongahela River, whose outlet in preglacial time was northward into the Erie basin. In the discussion of this paper, Mr. Gilbert called attention to the remarkable fact that the two main tributaries of the Mississippi, the Ohio on the east and the Missouri on the west, are both in large part streams of postglacial origin.

While the subject of Pleistocene Geology occupied a large part of the attention of the Section, other departments of geology were by no means neglected. Dr. E. O. Hovey gave an interesting account of an artesian boring at Key West, Fla., reaching a depth of 2000 feet. The boring was in limestone for the whole distance, although the rock exhibited considerable variation in texture. By the evidence of characteristic fossils, the summit of the Vicksburg formation was recognized 700 feet below the surface.

Prof. I. E. Todd presented interesting data from the numerous artesian wells in Dakota and the adjacent regions, whose abundant water supply is derived from the Dakota formation. In general, the water pressure in these wells is found to diminish eastward, but with local variations which it is by no means easy to explain.

Rev. H. C. Hovey, D. D., presented a paper on the Making of Mammoth Cave, which he attributed purely to the solvent action of water upon the limestone. Neither seismic disturbance, nor a supposed pot-hole action in the deep pits or depressions of the cave, can be considered to have had any considerable effect. Many measurements were given of different parts of the cave, which Dr. Hovey and his associates have most thoroughly explored. Dr. Hovey also described a newly discovered cave called the Colossal Cave.

Mr. W J McGee's paper on Sheet-flood Erosion called attention to the remarkable conditions existing in Papagueria, a district lying in southwestern Arizona and western Sonora, where an extensive area between mountain ranges has been planed off by the erosive action of water, and veneered with a thin sedimentary deposit. The erosion and deposition are due, not to streams concentrated in definite channels, but to the flowing of waters in broad sheets over the region after violent rains.

Prof. B. K. Emerson, in his paper on the Tuff Beds and other features of the Connecticut Valley Trias, called attention to some very remarkable phenomena. In some localities the broken surface of the extrusive trap sheets, with the calcareous or arenaceous deposits mingled with the trap, has been rolled under in the

onward flow of the trap, so that the same phenomena appear both at the top and bottom of the trap sheet. In certain localities the wet mud of the estuary bottom, over which the trap sheet flowed, has risen up into the trap, presenting an appearance very similar to that of true tuff beds. In these cases portions of the mud have been metamorphosed into a quartzite, and portions of the molten material of the trap, chilled by the ascending currents of mud and water, have solidified into a pitchstone or tachylite.

Prof. N. H. Winchell reported the discovery of fragmental volcanic deposits near Duluth, although no remains of craters had been recognized. It is remarkable that, amid the abundant interbedded igneous rocks of the Lake Superior region, only one find of fragmental volcanic deposits had hitherto been reported.

Prof. J. Perrin Smith gave a lucid account of the Physiography of California, illustrating it by a photograph of a relief map, which was projected on a screen. In discussing the causes of the present physiography, he dwelt especially upon the Tertiary and post-Tertiary uplifts and consequent erosion.

A number of interesting papers were presented in the department of Paleontology. Prof. E. W. Claypole's paper on Ancient and Modern Sharks gave an interesting account of the peculiarities of ancient sharks, as revealed by the recent discoveries of Dr. Clark and others in the Cleveland shale of northern Ohio. The remains referred to are remarkably well preserved, and throw much light upon the evolution of the Elasmobranchs.

Dr. C. R. Eastman gave a very interesting paper on the Dorsal Shields of the Dinichthyids. The median dorsal plate in these fishes bears a keel, which is comparatively slightly developed in Coccosteus, but attains a greater development in other genera of the group, reaching its maximum in Dinichthys and closely related genera, in which it is produced backward far beyond the margin of the plate. This keel is believed to serve for the attachment of muscles for swimming. Dinichthys livonicus, from Russia, first described by Pander as a species of Coccosteus, is the smallest and earliest species of Dinichthys, and the one most resembling Coccocteus. A comparison of the different species of Dinichthys shows that, as the genus moved westward from its starting point in eastern Europe, the species increased in size and in differentiation.

Mr. F. K. Mixer gave an account of recent discoveries of fossil fishes in the Hamilton and Portage formations of western New York. The discoveries indicate in the Portage of that region an abundant and varied fish fauna, including groups so diverse as those represented by Dinichthys, Holoptychius and Palæoniscus.

Mr. A. W. Grabau gave a detailed account of the succession of fossil faunas in the Hamilton group at Eighteen Mile Creek, near Buffalo. The comparison of the succession of faunas at Eighteen Mile Creek with that shown in the salt shaft at Livonia reveals a very interesting instance of migration, since the shale beneath the Encrinal Limestone at Eighteen Mile Creek contains essentially the same fauna found in a shale above the Encrinal Limestone at Livonia.

Prof. A. Hollick gave an account of the exposure of Cretaceous clay marl at Cliffwood, N. J. The fossils from this locality are poorly preserved, but are of great interest as marking a transition from the estuarine conditions of the Amboy clays to the marine conditions of the overlying marls. The deposit is considered to represent the Mattawan formation of Prof. W. B. Clark.

Prof. T. H. McBride exhibited microscopic sections of remains of Sigillarids and Conifers from the Carboniferous of Iowa.

The remains are so exquisitely preserved as to throw much light upon the nature of the Carboniferous flora.

In recent years a very important part of the work connected with the meeting of Section E and the summer meeting of the Geological Society has been in the line of excursions, under expert guidance, to interesting geological localities in the vicinity of the meeting. The geological excursions connected with the present meeting have been on a more extensive scale than ever before. For the week preceding the meeting of the Associotion, four excursions in different parts of the State of New York were proposed, but only two of them were carried out.

An excursion for the study of Pleistocene Geology commenced on Monday, August 17th, at Rochester, N. Y., under the direction of Prof. H. L. Fairchild. Monday was spent in the study of the phenomena of Lake Iroquois, in the vicinity of Rochester, and the kame moraine of the Pinnacle Hills. On Tuesday the party visited the high beaches lying east of the Genesee valley, arriving at Mount Morris for the night. On Wednesday the party visited the "High Banks" of the Genesee, near Mount Morris, and the Portage Falls, with the terraces above them, and the water-leveled drift which blocked the old valley. The night was spent at Portage. Thursday was spent in studying the beaches and moraines between Alden and Crittenden. Mr. Frank Leverett had intended to conduct the party the latter half of the week, but on account of sickness was unable to do so. The party accepted the invitation of Mr. B. W. Law to visit his home in the Cattaraugus valley; and Friday was spent in the study of the preglacial and postglacial channels of Cattaraugus Creek, the Warren glacial lake fillings, and the beaches at Eden Valley and Hamburg.

Another excursion, devoted especially to the study of Petrographic Geology, commenced on Monday, August 17th, at Port Henry, on Lake Champlain, under the direction of Prof. J. F. Kemp. Monday was spent in the study of the crystalline limestones, and the gabbros with their remarkable gneissoid modifications, in the immediate vicinity of Port Henry, and the great mines of magnetite at Mineville. Tuesday the party went by steamboat to Plattsburgh, studying on the way the titaniferous magnetites at Split Rock Mine and some of the numerous dikes along the shore. On Wednesday the party went by rail to Ausable Forks, and thence by stage through the Adirondacks to Lake Placid, passing through the magnificent fault valley of Wilmington Notch, and along the eastern foot of Whiteface Mountain. Thursday and Friday was spent at Gouverneur, under the direction of Prof. C. H. Smyth, Jr. The party studied the gneisses which form the prevalent rocks in the region, some of which seem to be granite dynamically metamorphosed, while others appear to have more the character of metamorphosed sediments. The crystalline limestones with their remarkable enclosures, the talc mines, the danburite locality in the town of Russell, and a remarkable instance of dynamic metamorphism in gabbro, were also studied.

During the meeting of the Association, the afternoon of Thursday was occupied by an excursion to Eighteen Mile Creek, and a study of the fossiliferous rocks, under the direction of Mr. Grabau, whose paper on the subject has been already mentioned.

Monday and Tuesday of the week following the meetings were occupied by an excursion for the study of the problems of Niagara, under the direction of Mr. G. K. Gilbert. The first day the party visited the Whirlpool, recognized the drift on the bank of the stream at that point as unmistakably in situ, climbed up through the ravine of Bowman's Creek, visited the remarkable

precipice at Wintergreen Flats (where a small branch of the river seems once to have made a cascade like the present American Fall) and recognized in the gorge the alternation between the broad and deep stretches of quiet water, corresponding to the high-water epochs during the erosion of the gorge, and the narrow and shallow stretches with swift and tumultuous current, corresponding to the low-water epochs. On Tuesday the route led over the supposed buried channel to St. David's ; and the party proceeded thence along the edge of the escarpment to Queenstown, returning, at the close of the day, from Lewiston to Niagara Falls by the railway in the gorge.

William North Rice,
Wesleyan University. *Secretary.*

SECTION H.—ANTHROPOLOGY.

The Section of Anthropology at the Buffalo meeting, American Association for the Advancement of Science, August 23d–28th, met on Monday morning for the transaction of the usual business, in addition to which it was this year necessary to elect a Secretary, because of the death of Capt. J. G. Bourke, who was chosen at the Springfield meeting. The place was filled by the election of G. H. Perkins, of the University of Vermont. In the afternoon the address of Miss A. C. Fletcher, Vice-President of the Section, was read, a most interesting, suggestive and valuable contribution to our knowledge of the religious ideas of the Dakotan peoples. Its subject was 'The Emblematic Use of the Tree in the Dakotan Group.' This address will be published in full in Science.

On Tuesday morning Section H, as was the case with all the Sections, settled down to the regular reading of papers. The programme of this and the following days was made far more orderly and helpful than it has been heretofore by reason of certain preliminary arrangements. A provisional programme had been arranged before the opening of the session, which was possible because, through the energy of the Vice-President, notice of the meeting and request for early sending of abstracts of papers which members intended to present had been sent to all those especially connected with the Section. The response to this request had been so hearty that the provisional programme required very little change as it was used from day to day. Another and convenient change was the arrangement of all papers, the titles of which had been received, under various headings, as Archæology, Ethnology, Somatology, and assigning one or more sessions to each heading. In this way, although absolute order could not be brought about because of the late arrival of authors and for other reasons, a reasonable degree of unity in the papers presented at each session was secured, very greatly to the advantage of both hearers and readers.

A large number of papers were offered to the Section, most of which were read, occupying all the time up to the last day of meeting. The quality of the papers was fully equal to that at previous meetings, and at adjournment the members of Section H agreed that a very profitable and enjoyable session had been held. The courtesy and good humor which prevailed during all the numerous discussions was noticeable. Many of the papers presented opinions with which all could not agree, but differences of opinion were always expressed in a most kindly manner. It is to be remembered that space allows no account of these discussions and that the papers are reported simply as presented by the authors and give only their views of the question treated.

It is also to the credit of the Section of Anthropology that it is the only Section which has recognized the justice of giving equal honor for equal work to woman as to man, and that a woman who has done good work in the department which the Section

represents is as fully entitled to recognition as a man. Years ago it elected a woman as its Secretary, and this year it honored itself in honoring Miss Fletcher by conferring upon her the position of presiding officer. And surely well deserved recognition of long and most important service in behalf of anthropology was never more satisfactorily bestowed than in this case. It is not flattery to say that no one could have presided over the meetings or attended to all the various duties which come to such a position with greater grace, fidelity or dignity, and it was well fitting that at the closing session a very hearty expression of appreciation of the delightful and efficient manner in which Miss Fletcher had filled her office should have been given by a rising vote.

Before the regular reading of papers a time had been set apart for the presentation of a resolution and a memorial concerning the late Capt. J. G. Bourke. On behalf of the Sectional Committee, W J McGee offered the following:

WHEREAS, This Section, the Association, the Nation and the scientific world have sustained an immeasurable loss in the death of John G. Bourke, scientist and soldier, and,

WHEREAS, The loss is peculiarly painful in the Section of Anthropology, to which he brought honor, long as a working member and later as Secretary; therefore,

Resolved, That this Section here assembled join in an expression of grief for the death, and of reverence for the memory of our associate and friend.

After the above had been read, Dr. D. G. Brinton read, in the absence of the author, a very appreciative and sympathetic memorial of Capt. Bourke, by his friend and fellow-laborer, Dr. Washington Matthews. Remarks expressing esteem for the work and character of our associate were made by Prof. Putnam, Prof. Perkins and Miss Fletcher, and the resolution was adopted by a rising vote.

The first paper on the programme was then read by Dr. H. C. Hovey, on 'Symbolic Rocks of Byfield and Newbury, Mass.' The author called attention to certain old monuments in colonial graveyards, and also to some milestones and stones in the foundations of some old houses which were carved in a manner wholly unlike that of Puritan monuments. The symbols upon these stones are pagan rather than Christian, being sun-disks, whorls, fleur-de-lis and rarely phallic signs. The masterpiece shows the sun god's bride, surrounded by symbolic invocations, and over all is delineated a rude sun-burst. Photographs were shown and reference was made to similar rocks in Ireland, Denmark and elsewhere.

The Secretary read for the author a brief paper by Mr. J. R. Chandler describing certain important ruins of Tzac Pokoma, Guatemala. These little known ruins are of very considerable importance and extent. "Numberless ruined temples, palaces, houses and walls are now visible." The ruins seem to be very ancient, and no sculptures or hieroglyphics have been found and very few implements.

Prof. Putnam read for Mr. C. C. Willoughby a very interesting 'Analysis of Decoration upon Pottery from the Mississippi Valley,' illustrated by numerous beautifully executed drawings. The author sought to show that much of the decoration was symbolic, the ornaments being religious in their nature.

Prof. G. F. Wright read a brief paper, in which he described a visit to the Lalor farm, near Trenton, N. J., where careful investigation revealed 'Fresh Geological Evidence of Glacial Man,' which was the title of his paper.

Prof. Putnam followed this paper with verbal statements as to the locality, methods of investigation and specimens found, many of which were exhibited, all going to corroborate the testimony given by Prof. Wright.

Prof. E. W. Claypole brought forward similar evidence from Ohio, with the exhibition of specimens, found in one case at a depth of 22 feet in gravel that apparently could not have been disturbed since glacial times.

With this closed the day assigned to Archæology, though other papers properly set for this time came later, through unavoidable conditions. On Wednesday, by recommendation of the Sectional Committee, a committee was appointed "For the purpose of advancing an acquaintance with the objects of Section H among both members and non-members." This committee consists of J. McK. Cattell, D. G. Brinton, Franz Boas.

Dr. D. G. Brinton presented the following:

WHEREAS, The influence which the environment of the New World has exerted upon the physical and mental development of the White Race is a question of the utmost scientific and practical importance, and,

WHEREAS, There appears to be no governmental or scientific bureau which is giving the subject attention at the present time; therefore,

Resolved, That the American Association for the Advancement of Science appoint a committee to organize an Ethnological Investigation of the White Race in the United States, with special reference to the influence exerted upon it in its new surroundings, said Committee to report annually.

According to rule this was, after adoption by the Section, referred to the Council by whom it was passed and the Section requested to nominate said committee. The Section did so, and by vote of the Council the following were appointed as such committee: D. G. Brinton, J. McK. Cattell, W. W. Newell, W J McGee, Franz Boas.

The programme of this day was especially given to Ethnology. Dr. McGee gave a very interesting account of a tribe of Indians, the Seri, living on Tiburon Island, in the Gulf of California, and exhibited specimens of their stone implements. He showed how very rude these people are in all their arts and conditions. His title was 'Seri Stone Art.'

This was followed by a carefully prepared paper by Horatio Hale on 'Indian Wampum Records.' The author referred to the use of wampum as money and as a method of recording events or transcribing messages. Wampum was used in very early times and by many peoples. This was an interesting and valuable paper.

Dr. Brinton read a paper on 'The Psychic Source of Myths,' which would have come on the following day, but the author being obliged to leave town it was read at this time. The author called attention to a common idea that by comparing numerous elements in different myths, and thus discovering that many are identical, a common origin is proved. But this method does not take into account the essential unity of the human mind, wherever it may be, and the laws which govern its activity. Because of the tendency of mind everywhere and in all conditions to act in the same manner we find myths of very similar sort in all parts of the world. Numerous examples illustrating this were given. Myths may, therefore, be very similar and yet very diverse in origin.

Dr. Boas then read a paper on 'The Limitations of the Comparative Method in Anthropology,' which will appear in full in SCIENCE.

Judge G. P. Thurston followed with a paper on 'Ceremonial Flint Implements and Shell Gorgets from Tennessee.' Most superb specimens of both classes of the objects named in the title were exhibited. No finer examples of aboriginal work have ever been found than these, both as to size and elegance of workmanship. On one of the circular gorgets was engraved a human figure, holding in one hand a head and in the other as a scepter or emblem a stone object, the duplicate of one exhibited.

Dr. W. M. Beauchamp gave a very care-

ful account of 'Aboriginal Occupation of New York,' illustrated by a finely drawn map.

On Thursday the subject was Somatology and Psychology, but other papers were also read. Mr. Harlan I. Smith, in a paper on 'The Preservation of Local Archæological Evidence,' gave some very sensible and practical suggestions as to this subject. He also, in a following paper, gave a very interesting account of 'Ojibway Shamanistic Ceremonies' in treating sickness, and exhibited a bone tube used by the Shaman in sucking the diseased part in order to draw out the evil spirit.

Dr. J. McK. Cattell read a most suggestive paper on 'Physical and Mental Measurements of Students of Columbia University.' In this paper the importance of such investigation was shown, the methods employed and the results obtained.

Dr. Boas, in a paper on 'Anthropometry of the Shoshone Indians,' gave some interesting results from numerous physical measurements made among these people.

Mr. Haliburton gave an account of his studies upon dwarfs in a paper entitled 'Recent Discoveries as to Pygmy Races.' Pygmies as found in Guiana, Mexico, Honduras, Algeria, Spain and elsewhere were discussed and some interesting conclusions given.

'Onondaga Games' was the subject of a very interesting paper by Dr. Beauchamp, in which sundry games of ball, bone buttons, bow and arrow, etc., were briefly described.

Very peculiar ideas regarding time were described in a paper on 'Papago Time Concepts' by Mr. McGee.

A paper by Mrs. F. D. Bergen on 'The Theological Development of one Child' consisted of a curious account of the ideas of a child who was carefully guarded against receiving any teachings concerning spiritual matters until ten or twelve years old.

Miss Fletcher's valuable paper on 'Certain Beliefs Concerning the Will Power Among the Siouan Tribes' will be given to the readers of Science in full.

Mr. McGee's paper on the 'Beginnings of Zooculture' proposed an original and plausible theory to account for the domestication of animals.

Mr. W. W. Tooker presented a full discussion of the 'Meaning of the Name Manhattan,' to be published in the Brooklyn Almanac. He concluded that there was the best of evidence for believing Manhattan to mean 'The Island of Hills.'

At the close of Thursday's session, Mr. McGee, for the Sectional Committee, presented the following resolution:

Whereas, Horatio Hale, long an active member and at one time a Vice-President of this Association, has made contributions to Ethnology and Philology, entitling him to a place in the front ranks of American Anthropologists, and,

Whereas, It seems fitting that Mr. Hale's long and arduous labors in behalf of science should be recognized by the American Association for the Advancement of Science; therefore,

Resolved, That Section H recommend to the Council that Mr. Hale be made a Life Fellow of this Association.

This was adopted, and the Council received the recommendation and elected Mr. Hale a Life Fellow.

Friday was assigned to papers in General Anthropology. A paper from Mr. H. Saville on 'The Ruins of the Temple of Tepoztlan,' was read. These ruins, important for many reasons, are especially so as they are the only American ruins to which a definite date can be set. On one of two slabs in one of the walls is engraved the sign of Ahuizotl, the immediate predecessor of Montezuma, and on the other the date, ten Tochtli, which corresponds to 1502.

Other papers, of which no account can be given for lack of space, are: a long and most interesting account of 'Explorations in Honduras by the Peabody Museum,' given by

Prof. Putnam; 'Results of Recent Cave Exploration in the United States,' by H. C. Mercer; 'Kootenay Indian Place Names and Names of Implements,' by Prof. A. F. Chamberlain; 'Clan System of the Pueblos,' by F. W. Hodge. A very suggestive paper by Rev. Dr. Richert on 'Character and Food.' An account of 'Finland Vapor Baths,' by Mr. H. W. Smith, and an account of certain uses in religious ceremonies of the 'Mescal Plant,' by James Mooney.

The officers elected for next year for this Section are: *Vice President*, W J McGee, Washington, D. C.; *Secretary*, H. I. Smith, New York.

G. H. PERKINS,
Secretary.

UNIVERSITY OF VERMONT.

THE SOCIETY FOR THE PROMOTION OF AGRICULTURAL SCIENCE.

THE seventeenth annual meeting of the Society for the Promotion of Agricultural Science was held at Buffalo, N. Y., in the Public Library Building, on August 21st and 22d. The meeting was the most successful one of recent years. Fifteen papers, on the following subjects, were read, most of the authors being present in person:

W. R. LAZENBY. *Presidential address. The Relation of Science to Agriculture.*

A. D. HOPKINS: On varieties of timothy and red clover.

Pollen-distributing insects observed on flowers of timothy and red clover.

V. A. MOORE: The influence of animal experimentation upon agriculture.

C. C. GEORGESON: Steer feeding experiments at the Kansas Experiment Station.

L. O. HOWARD: A biographical sketch of Dr. C. V. Riley.

B. M. DUGGAR (By invitation): *Sporotrichum globuliferum:* White muscardine of the chinch bug economically considered.

E. A. DE SCHWEINITZ: An anti-toxic serum for hog cholera and swine plague. The production of immunity to hog cholera by means of the blood serum of immune animals.

H. L. BOLLEY: The relation of the time of feeding and the period of development, to the development of rusts and smuts in oats. Also some further experiments on potato scab.

F. D. CHESTER: Protective inoculation against anthrax.

H. C. IRISH (By invitation): Forcing cauliflower with lettuce and cucumbers.

W. A. KELLERMAN (By invitation): New experiments with fungicides for smuts of wheat and oats.

C. E. BESSEY: A biographical sketch of Prof. C. L. Ingersoll.

F. WM. RANE: Electro-Horticulture: range of incandescent lamps.

L. H. PAMMEL and F. L. SCRIBNER: Notes on grasses collected between Jefferson, Iowa, and Denver, Colorado.

The old board of officers, composing the following persons, was reelected for the ensuing year: President, W. R. Lazenby, Ohio State University, Columbus, O.; Secretary and Treasurer, C. S. Plumb, Purdue University, LaFayette, Ind.; third member Executive Committee, L. O. Howard, Department of Agriculture, Washington.

C. S. PLUMB,
Secretary.

*BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.**

ADDRESS BY THE PRESIDENT TO THE MATHEMATICAL AND PHYSICAL SECTION.

THERE is a melancholy reminiscence connected with this meeting of our Section, for when the British Association last met in Liverpool the chair in Section A was occupied by Clerk-Maxwell. In the quarter of a century which has elapsed since that meeting, one of the most important advances made in our science has been the researches which, inspired by Maxwell's view of electrical action, confirmed that view, and revolutionized our conception of the processes occurring in the Electro-magnetic field. When the Association last met in Liverpool Maxwell's view was almost without supporters, to-day its opponents are fewer than its supporters then. Maxwell's theory, which is the development and extension of

*Liverpool meeting, beginning September 16, 1896.

Faraday's, has not only affected our way of regarding the older phenomena of electricity, it has, in the hands of Hertz and others, led to the discovery of whole regions of phenomena previously undreamt of. It is sad to think that his premature death prevented him from reaping the harvest he had sown. His writings are, however, with us, and are a storehouse to which we continually turn, and never, I think, without finding something valuable and suggestive.

'Thus ye teach us day by day,
Wisdom, though now far away.'

The past year has been rich in matters of interest to physicists. In it has occurred the jubilee of Lord Kelvin's tenure of the Professorship of Natural Philosophy at the University of Glasgow. Some of us were privileged to see this year at Glasgow an event unprecedented in the history of physical science in England, when congratulations to Lord Kelvin on the jubilee of his professorship were offered by people of every condition and country. Every scientific society and every scientific man is Lord Kelvin's debtor; but no society and no body of men owe him a greater debt than Section A of the British Association; he has done more for this section than any one else, he has rarely missed its meetings, he has contributed to the section papers which will make its proceedings imperishable, and by his enthusiasm he has year by year inspired the workers of this section to renew with increased vigour their struggle to penetrate the secrets of nature. Long may we continue to receive from him the encouragement and assistance which have been so freely given for the past half century.

By the death of Sir W. R. Grove, the inventor of Grove's cell, we have lost a physicist whose name is a familiar one in every laboratory in the world. Besides the Grove cell, we owe to him the discovery of the gas battery, and a series of researches on the electrical behavior of gases, whose importance is only now beginning to be appreciated. His essay on the correlation of the physical forces had great influence in promoting that belief in the unity of the various branches of physics which is one of the characteristic features of modern and natural philosophy.

In the late Prof. Stoletow, of Moscow, we have lost the author of a series of most interesting researches on the electrical properties of gases illuminated by ultra-violet light, researches which, from their place of publication, are, I am afraid, not so well known in this country as they deserve to be.

As one who unfortunately of late years has had only too many opportunities of judging of the teaching of science in our public and secondary schools, I should like to bear testimony to the great improvement which has taken place in the teaching of physics in these schools during the past ten years. The standard attained in physics by the pupils of these schools is increasing year by year, and great credit is due to those by whose labors this improvement has been accomplished. I hope I may not be considered ungrateful if I express the opinion that in the zeal and energy which is now spent in the teaching of physics in schools, there may lurk a temptation to make the pupils cover too much ground. You may by careful organization and arrangement ensure that boys shall be taken over many branches of physics in the course of a short time; it is indeed not uncommon to find boys of 17 or 18 who have compassed almost the whole range of physical subjects. But although you may increase the rate at which information is acquired, you cannot increase in anything like the same proportion the rate at which the subject is assimilated, so as to become a means of strengthening the mind and a permanent

mental endowment when the facts have long been forgotten.

Physics can be taught so as to be a subject of the greatest possible educational value, but when it is so it is not so much because the student acquires a knowledge of a number of interesting and important facts, as by the mental training the study affords in, as Maxwell said, 'bringing our theoretical knowledge to bear on the objects and the objects on our theoretical knowledge.' I think this training can be got better by going very slowly through such a subject as mechanics, making the students try innumerable experiments of the simplest and, what is a matter of importance in school teaching, of the most inexpensive kind, but always endeavoring to arrive at numerical results, rather than by attempting to cover the whole range of mechanics, light, heat, sound, electricity and magnetism. I confess I regret the presence in examinations intended for school boys of many of these subjects.

I think, too, that in the teaching of physics at our universities, there is perhaps a tendency to make the course too complex and too complete. I refer especially to the training of those students who intend to become physicists. I think that after a student has been trained to take accurate observations, to be alive to those pitfalls and errors to which all experiments are liable; mischief may in some cases be done if he is kept performing elaborate experiments, the results of which are well known with the view of learning a knowledge of methods. It is not given to many to wear a load of learning lightly as a flower. With many students a load of learning, especially if it takes a long time to acquire it, is apt to crush enthusiasm. Now, there is, I think, hardly any quality more essential to success in physical investigations than enthusiasm. Any investigation in experimental physics requires a large expenditure of both time and patience; the apparatus seldom, if ever, begins by behaving as it ought; there are times when all the forces of nature, all the properties of matter, seem to be fighting against you; the instruments behave in the most capricious way, and we appreciate Coutts Trotter's saying, that the doctrine of the constancy of nature was never discovered in a laboratory.

These difficulties have to be overcome, but it may take weeks or months to do so, and unless the student is enthusiastic, he is apt to retire disheartened from the contest. I think, therefore, that the preservation of youthful enthusiasm is one of the most important points for consideration in the training of physicists. In my opinion this can best be done by allowing the student, even before he is supposed to be acquainted with the whole of physics, to begin some original research of a simple kind under the guidance of a teacher who will encourage him and assist in the removal of difficulties. If the student once tastes the delights of the successful completion of an investigation, he is not likely to go back, and will be better equipped for investigating the secrets of nature than if, like the White Knight in 'Alice of Wonderland,' he commenced his career provided with the means of measuring or weighing every physical quantity under the sun, but with little desire or enthusiasm to have anything to do with any of them. Even for those students who intend to devote themselves to other pursuits than physical investigation, the benefits derived from original investigation as a means of general education can hardly be over-estimated, the necessity it entails of independent thought, perseverance in overcoming difficulties, and the weighing of evidence gives it an educational value which can hardly be rivalled. We have to congratulate ourselves that through the munificence of Mr. Ludwig Mond, in building and en-

dowing a laboratory for research, the opportunities for pursuing original investigations in this country have been greatly increased.

The discovery at the end of last year by Prof. Röntgen of a new kind of radiation from a highly exhausted tube through which an electric discharge is passing, has aroused an amount of interest unprecedented in the history of physical science. The effects produced *inside* such a tube by the cathode rays, the bright phosphorescence of the glass, the shadows thrown by opaque objects, the deflection of the rays by a magnet, have, thanks to the researches of Crookes and Goldstein, long been familiar to us, but it is only recently that the remarkable effects which occur outside such a tube have been discovered. In 1893, Lenard, using a tube provided with a window made of a very thin plate of aluminium, found that a screen impregnated with a solution of a phosphorescent substance became luminous if placed outside the tube in the prolongation of the line from the cathode through the aluminium window. He also found that photographic plates placed outside the tube in this line were affected, and electrified bodies were discharged; he also obtained by these rays photographs through plates of aluminium or quartz. He found that the rays were affected by a magnet, and regarded them as the prolongations of the cathode rays. This discovery was at the end of last year followed by that of Röntgen who found that the region round the discharge tube is traversed by rays which can affect a photographic plate after passing through substances such as aluminium or cardboard, which are opaque to ordinary light; which pass from one substance to another, without any refraction, and with but little regular reflection; and which are not affected by a magnet. We may, I think, for the purposes of discussion, conveniently divide the rays occurring in or near a vacuum tube traversed by an electric current into three classes, without thereby implying that they are necessarily distinctly different in physical character. We have (1) the cathode rays inside the tube, which are deflected by a magnet; (2) the Lenard rays outside the tube, which are also deflected by a magnet; and (3) the Röntgen rays, which are not, as far as is known, deflected by a magnet. Two views are held as to the nature of the cathode rays; one view is, that they are particles of gas carrying charges of negative electricity, and moving with great velocities which they have acquired as they travelled through the intense electric field which exists in the neighborhood of the negative electrode. The phosphorescence of the glass is on this view produced by the impact of these rapidly moving charged particles, though whether it is produced by the mechanical violence of the impact, or whether it is due to an electro-magnetic impulse produced by the sudden reversal of the velocity of the negatively charged particle—whether, in fact, it is due to mechanical or electrical causes, is an open question. This view of the constitution of the cathode rays explains in a simple way the deflection of those rays in a magnetic field, and it has lately received strong confirmation from the results of an experiment made by Perrin. Perrin placed inside the exhausted tube a cylindrical metal vessel with a small hole in it, and connected this cylinder with the leaves of a gold leaf electroscope. The cathode rays could, by means of a magnet, be guided so as either to pass into the cylinder through the aperture, or turned quite away from it. Perrin found that when the cathode rays passed into the cylinder the gold leaf of the electroscope diverged, and had a negative charge, showing that the bundle of cathode rays enclosed by the cylinder had a charge of negative electricity. Crookes had many years ago exposed a disc

connected with a gold leaf electroscope to the bombardment of the cathode rays, and found that the disc received a slight *positive* charge; with this arrangement, however, the charged particles had to give up their charges to the disc if the gold leaves of the electroscope were to be affected, and we know that it is extremely difficult, if not impossible, to get electricity out of a charged gas merely by bringing the gas in contact with a metal. Lord Kelvin's electric strainers are an example of this. It is a feature of Perrin's experiment that since it acts by induction, the indications of the electroscope are independent of the communication of the charges of electricity from the gas to the cylinder, and since the cathode rays fall on the inside of the cylinder, the electroscope would not be affected, even if there were such an effect as is produced when ultra-violet light falls upon the surface of an electro-negative metal when the metal acquires a positive charge. Since any such process cannot affect the total amount of electricity inside the cylinder, it will not affect the gold leaves of the electroscope; in fact, Perrin's experiments prove that the cathode rays carry a charge of negative electricity.

The other view held as to the constitution of the cathode rays is that they are waves in the ether. It would seem difficult to account for the result of Perrin's experiment on this view, and also I think very difficult to account for the magnetic deflection of the rays. Let us take the case of a uniform magnetic field, the experiments which have been made on the magnetic deflection of these rays seem to make it clear that in a magnetic field which is sensibly uniform, the path of these rays is curved; now if these rays were due to ether waves, the curvature of the path would show that the velocity of propagation of these waves varied from point to point of the path. That is, the velocity of propagation of these waves is not only affected by the magnetic field, it is affected differently at different parts of the field. But in a uniform field what is there to differentiate one part from another, so as to account for the variability of the velocity of wave propagation in such a field? This could not be accounted for by supposing that the velocity of this wave motion depended on the strength of the magnetic field, or that the magnetic field, by distorting the shape of the boundary of the negative dark space, changed the direction of the wave front, and so produced a deflection of the rays. The chief reason for supposing that the cathode rays are a species of wave motion is afforded by Lenard's discovery, that when the cathode rays in a vacuum tube fall on a thin aluminium window in the tube, rays having similar properties are observed on the side of the window outside the tube; this is readily explained on the hypothesis that the rays are a species of wave motion to which the window is partially transparent, while it is not very likely that particles of the gas in the tube could force their way through a piece of metal. This discovery of Lenard's does not, however, seem to me incompatible with the view that the cathode rays are due to negatively charged particles moving with high velocities. The space outside Lenard's tube must have been traversed by Röntgen rays, these would put the surrounding gas in a state in which a current would be readily started in the gas if any electro-motive force acted upon it. Now, though the metal window in Lenard's experiments was connected with the earth, and would, therefore, screen off from the outside of the tube any effect arising from slow electrostatic changes in the tube, it does not follow that it would be able to screen off the electrostatic effect of charged particles moving to and from the tube with very great rapidity. For in order to screen

off electrostatic effects, there must be a definite distribution of electrification over the screen; changes in this distribution, however, take a finite time, which depends upon the dimensions of the screen and the electrical conductivity of the material of which it is made. If the electrical changes in the tube take place at above a certain rate, the distribution of electricity on the screen will not have time to adjust itself, and the screen will cease to shield off all electrostatic effects. Thus the very rapid electrical changes which would take place if rapidly moving charged bodies were striking against the window, would give rise to electro-motive forces in the region outside the window, and would produce convection currents in the gas which has been made a conductor by the Röntgen rays. The Lenard rays would thus be analogous in character to the cathode rays, both being convective currents of electricity. Though there are some points in the behavior of these Lenard rays which do not admit of a very ready explanation from this point of view, yet the difficulties in its way seem to me considerably less than that of supposing that a wave in the ether can change its velocity when moving from point to point in a uniform magnetic field.

I now pass on to the consideration of the Röntgen rays. We are not yet acquainted with any crucial experiment which shows unmistakably that these rays are waves of transverse vibration in the ether, or that they are waves of normal vibration, or indeed that they are vibrations at all. As a working hypothesis, however, it may be worth while considering the question whether there is any property known to be possessed by these rays which is not possessed by some form or other of light. The many forms of light have in the last few months received a noteworthy addition by the discovery of M. Becquerel of an invisible radiation, possessing many of the properties of the Röntgen rays, which is emitted by many fluorescent substances, and to an especially marked extent by the uranium salts. By means of this radiation, which, since it can be polarized, is unquestionably light, photographs through opaque substances similar, though not so beautiful to those obtained by means of Röntgen rays, can be taken, and, like the Röntgen rays, they cause an electrified body on which they shine to lose its charge, whether this be positive or negative.

The two respects in which the Röntgen rays differ from light is in the absence of refraction and perhaps of polarization. Let us consider the absence of refraction first. We know cases in which special rays of the spectrum pass from one substance to another without refraction; for example, Kundt showed that gold, silver, copper allowed some rays to pass through them without bending, while other rays are bent in the wrong direction. Pflüger has lately found that the same is true for some of the aniline dyes when in a solid form. In addition to this, the theory of dispersion of light shows that there will be no bending when the frequency of the vibration is very great. I have here a curve taken from a paper by Helmholtz, which shows the relation between the refractive index and the frequency of vibration for a substance whose molecules have a natural period of vibration, and one only; the frequency of this vibration is represented by OK in the diagram. The refractive index increases with the frequency of the light until the latter is equal to the frequency of the natural vibration of the substance; the refractive index then diminishes, becomes less than unity, and finally approaches unity, and practically is equal to it when the frequency of the light greatly exceeds that of the natural vibration of the molecule. Helmholtz's results are obtained on the supposition that a molecule of the refracting substance consists of a pair of oppositely electrified atoms,

and that the specific inductive capacity of the medium consists of two parts, one due to the ether, the other to the setting of the molecules along the lines of electric force.

Starting from this supposition we can easily see without mathematical analysis that the relation between the refractive index and the frequency must be of the kind indicated by the curve. Let us suppose that an electro-motive force of given amplitude acts on this mixture of molecules and ether, and start with the frequency of the external electro-motive force less than that of the free vibrations of the molecules; as the period of the force approaches that of the molecules, the effect of the force in pulling the molecules into line will increase, thus the specific inductive capacity; and therefore, the refractive index, increases with the frequency of the external force; the effect of the force on the orientation of the molecules will be greatest when the period of the force coincides with that of the molecules. As long as the frequency of the force is less than that of the molecules, the external field tends to make the molecules set so as to increase the specific inductive capacity of the mixture; as soon, however, as the frequency of the force exceeds that of the molecules, the molecules, if there are no viscous forces, will all topple over and point so as to make the part of the specific inductive capacity due to the molecules of opposite sign to that due to the ether. Thus, for frequencies greater than that of the molecules the specific inductive capacity will be less than unity. When the frequency of the force only slightly exceeds that of the molecules, the effect of the external field on the molecules is very great, so that if there are a considerable number of molecules, the negative part of the specific inductive capacity due to the molecules may be greater than the positive part due to the ether, so that the specific inductive capacity of the mixture of molecules and ether would be negative; no waves of this period could then travel through the medium, they would be totally reflected from the surface.

As the frequency of the force gets greater and greater, its effect in making the molecules set will get less and less, but the waves will continue to be totally reflected until the negative part of the specific inductive capacity due to the molecules is just equal to the positive part due to the ether. Here the refractive index of the mixture is zero. As the frequency of the force increases, its effect on the molecules gets less and less, so that the specific inductive capacity continually approaches that due to the ether alone, and practically coincides with it as soon as the frequency of the force is a considerable multiple of that of the molecules. In this case both the specific inductive capacity and the refractive index of the medium are the same as that of the ether and there is consequently no refraction. Thus the absence of refraction, instead of being in contradiction to the Röntgen rays, being a kind of light, is exactly what we should expect if the wave length of the light were exceedingly small.

The other objection to these rays being a kind of light is, that there is no very conclusive evidence of the existence of polarization. Numerous experiments have been made on the difference between the absorption of these rays by a pair of tourmaline plates when their axes are crossed or parallel. Many observers have failed to observe any difference at all between the absorption in the two cases. Prince Galitzine and M. de Karnogitsky, by a kind of cumulative method, have obtained photographs which seem to show that there is a slightly greater absorption when the axes are crossed than there is when the axes are parallel. There can, however, be no question that the effect, if it exists at all, is exceedingly small compared with the corresponding effect for visi-

ble light. Analogy, however, leads us to expect that to get polarization effects we must use in the case of short waves, polarizers of a much finer structure than would be necessary for long ones. Thus a wire bird-cage will polarize long electrical waves, but will have no effect on visible light. Rubens and Dubois made an instrument which would polarize the infra red rays by winding very fine wires very close together on a framework; this arrangement, however, was too coarse to polarize visible light. Thus, though the structure of the tourmaline is fine enough to polarize the visible rays, it may be much too coarse to polarize the Röntgen rays if these have exceedingly small wave-lengths. As far as our knowledge of these rays extends, I think we may say that though there is no direct evidence that they are a kind of light, there are no properties of the rays which are not possessed by some variety of light.

It is clear that if the Röntgen rays are light rays, their wave-lengths are of an entirely different order to those of visible light. It is, perhaps, worth notice that on the electro-magnetic theory of light we might expect two different types of vibration if we suppose that the atoms in the molecule of the vibrating substance carried electrical charges. One set of vibrations would be due to the oscillations of the bodies carrying the charges, the other set to the oscillation of the charges on these bodies. The wave-length of the second set of vibrations would be commensurate with molecular dimensions; can these vibrations be the Röntgen rays? If so, we should expect them to be damped with such rapidity as to resemble electrical impulses rather than sustained vibrations.

If we turn from the rays themselves to the effects they produce, we find that the rays alter the properties of the substances through which they are passing. This change is most apparent in the effects produced on the electrical properties of the substances. A gas, for example, while transmitting these rays, is a conductor of electricity. It retains its conducting properties for some little time after the rays have ceased to pass through it, but Mr. Rutherford and I have lately found that the conductivity is destroyed if a current of electricity is sent through the Röntgenized gas. The gas in this state behaves in this respect like a very dilute solution of an electrolyte. Such a solution would cease to conduct after enough electricity had been sent through it to electrolyze all the molecules of the electrolyte. When a current is passing through a gas exposed to the rays, the current destroys and the rays produce the structure which gives conductivity to the gas; when things have reached a steady state the rate of destruction by the current must equal the rate of production by the rays. The current can thus not exceed a definite value, otherwise more of the conducting gas would be destroyed than is produced.

This explains the very characteristic feature that in the passage of electricity through gases exposed to Röntgen rays, the current, though at first proportional to the electro-motive force, soon reaches a value where it is almost constant and independent of the electro-motive force, and we get to a state when a tenfold increase in the electro-motive force only increases the current by a few per cent. The conductivity under the Röntgen rays varies greatly from one gas to another, the halogens and their gaseous compounds, the compounds of sulphur, and mercury vapor, are among the best conductors. It is worthy of note that those gases which are the best conductors when exposed to the rays are either elements, or compounds of elements, which have in comparison with their valency very high refractive indices.

The conductivity conferred by the rays

on a gas is not destroyed by a considerable rise in temperature ; it is, for example, not destroyed if it be sucked through metal tubing raised to a red heat. The conductivity is, however, destroyed if the gas is made to bubble through water, it is also destroyed if the gas is forced through a plug of glass wool. This last effect seems to indicate that the structure which confers conductivity on the gas is of a very coarse kind, and we get confirmation of this from the fact that a very thin layer of gas exposed to the Röntgen rays does not conduct nearly so well as a thicker one. I think we have evidence from other sources that electrical conduction is a process that requires a considerable space—a space large enough to enclose a very large number of molecules.

Thus Koller found that the specific resistances of petroleum, turpentine and distilled water, when determined from experiments made with very thin layers of these substances, was very much larger than that determined from experiments with thicker layers. Even in the case of metals there is evidence that the metal has to be of appreciable size if it is to conduct electricity. The theory of the scattering of light by small particles shows that, if we assume the truth of the electro-magnetic theory of light, the effects should be different according as the small particles are insulators or conductors. When the small particles are non-conductors, theory and experiment concur in showing that the direction of complete polarization for the scattered light is at right angles to the direction of the incident light, while if the small particles are conductors, theory indicates that the direction of complete polarization makes an angle of 60° with the incident light. This result is not, however, confirmed by the experiments made by Prof. Threlfall on the scattering of light by very small particles of gold. He found that the gold scattered the light in just the same way as a non-conductor, giving complete polarization at right angles to the incident light. This would seem to indicate that those very finely divided metallic particles no longer acted as conductors. Thus there seems evidence that in the case of conduction through gases, through badly conducting liquids and through metals, electric conduction is a process which requires a very considerable space and aggregations of large numbers of molecules. I have not been able to find any direct experimental evidence as to whether the same is true for electrolytes. Experiments on the resistance of thin layers of electrolytes would be of considerable interest, as according to one widely accepted view of electrolysis conduction through electrolytes, so far from being effected by aggregations of molecules, takes places by means of the ion, a structure simpler than that of the molecule, so that if this represents the process of conduction, there would not seem room for the occurrence of an effect which occurs with every other kind of conduction.

In this building it is only fitting that some reference should be made to the question of the movement of the ether. You are all doubtless acquainted with the heroic attempts made by Prof. Lodge to set the ether in motion, and how successfully the ether resisted them. It seems to be conclusively proved that a solid body in motion does not set in motion the ether at an appreciable distance outside it ; so that if the ether is disturbed at all in such a case, the disturbance is not comparable with that produced by a solid moving through an incompressible fluid, but must be more analogous to that which would be produced by the motion through the liquid of a body of very open structure, such as a piece of wire netting, where the motion of the fluid only extends to a distance comparable with the diameter of the wire, and not

with that of the piece of netting. There is another class of phenomena relating to the movement of the ether which is, I think, deserving of consideration, and that is the effect of a varying electro-magnetic field in setting the ether in motion. I do not remember to have seen it pointed out that the electro-magnetic theory of light implicitly assumes that the ether is not set in motion even when acted on by mechanical forces. On the electro-magnetic theory of light such forces do exist, and the equations used are only applicable when the ether is at rest. Consider, for example, the case of a plane electric wave travelling through the ether. We have parallel to the wave-front a varying electric polarization, which on the theory is equivalent to a current; at right angles to this, and also in the wave-front, we have a magnetic force. Now, when a current flows through a medium in a magnetic field there is a force acting on the medium at right angles to the plane, which is parallel both to the current and to the magnetic force; there will thus be a mechanical force acting on each unit volume of the ether when transmitting an electric wave, and since this force is at right angles to the current and to the magnetic force, it will be in the direction in which the wave is propagated. In the electro-magnetic theory of light, however, we assume that this force does not set the ether in motion, as unless we made this assumption we should have to modify our equations, as the electro-magnetic equations are not the same in a moving field as in a field at rest. In fact, a complete discussion of the transmission of electro-magnetic disturbances requires a knowledge of the constitution of the ether which we do not possess. We now assume that the ether is not set in motion by an electro-magnetic wave. If we do not make this assumption we must introduce into our equation quantities representing the components of the velocity of the ether, and unless we know the constitution of the ether, so as to be able to deduce these velocities from the forces acting on it, there will be in the equations of the electro-magnetic field more unknown quantities than we have equations to determine. It is, therefore, a very essential point in electro-magnetic theory to investigate whether or not there is any motion of the ether in a varying electro-magnetic field. We have at the Cavendish Laboratory, using Prof. Lodge's arrangement of interference fringes, made some experiments to see if we could detect any movement of the ether in the neighborhood of an electric vibrator, using the spark which starts the vibrations as the source of light. The movement of the ether, if it exists, will be oscillatory, and with an undamped vibrator the average velocity would be zero; we used, therefore, a heavily damped vibrator, with which the average velocity might be expected to be finite. The experiments are not complete, but so far the results are entirely negative. We also tried by the same method to see if we could detect any movement of the ether in the neighborhood of a vacuum tube emitting Röntgen rays, but could not find any trace of such a movement. Prof. Threlfall, who independently tried the same experiment, has, I believe, arrived at the same conclusion.

Unless the ether is immovable under the mechanical forces in a varying electro-magnetic field, there are a multitude of phenomena awaiting discovery. If the ether does move, then the velocity of transmission of electrical vibrations, and therefore of light, will be affected by a steady magnetic field. Such a field, even if containing nothing but ether, will behave towards light like a crystal, and the velocity of propagation will depend upon the direction of the rays. A similar result would also hold in a steady electric field. We

may hope that experiments on these and similar points may throw some light on the properties of that medium which is universal, which plays so large a part in our explanation of physical phenomena, and of which we know so little.

J. J. THOMSON.

CURRENT NOTES ON ANTHROPOLOGY.

PATHOLOGY IN ANTHROPOLOGY.

IN a note in SCIENCE, May 1st, I vindicated the importance of the study, in anthropology, of pathological traits and processes. In the *Revue Mensuelle de l'Ecole d'Anthropologie* for July 15th is an excellent article on the same theme from Prof. Capitan. He sets forth with brevity and precision the many applications of pathology in anthropologic investigations. For instance, the diseased conditions of bones throw much light on prehistoric society; the disturbances of nutrition and reproduction solve many a problem in ethnic biology; defects in the organs of the senses explain the traits of various tribes; endemic, epidemic and hereditary diseases control the development of nations; migrations and dispersions are governed by similar causes; mental maladies are fruitful of extraordinary results in ethnic history, and so on.

But he takes a step further, a bold one, and, one must say, not a false one. "The generally received notion that humanity at large is in a healthy condition, normal and physiological, is an utter error. There is not a single individual, still less a large number, who are thoroughly sound; we always study them in a more or less diseased condition." There is no doubt this is so, and its consequences deserve far more attention than they have received.

THE CROWD AS AN ANTHROPIC UNIT.

ETHNOGRAPHERS have been accustomed to deal with the 'race,' the 'tribe' and the 'nation' as social or anthropic units; but of late it has become evident that the 'crowd,' any crowd, anywhere, anytime, is just as specialized, has as many individual traits, and is quite as active in its influence, as either of those mentioned. The 'crowd' may be in the salon of a lady of fashion, on a corner in the slums, or at a meeting of a scientific association; it will have the same peculiarities and move according to the same laws. It will act on impulse and not on reason; its intelligence is that of its most inferior members; but its powers are prompt and far-reaching. Mental suggestion and mental contagion are its favorite stimuli. It loves catch-words, symbols, colors and costumes. It prizes a badge far above a syllogism, and can be captured by the former when the latter would fall powerless.

The study of this many-headed beast has very properly come into the scope of anthropology, and the little book of Dr. Gustave Le Bon, 'Psychologie des foules' (Alcan, Paris), as well as the lectures of Prof. Bernheim, of Nancy, on 'Suggestion collective,' enable the reader to appreciate how singularly the folly of the mass obscures the wisdom of the individual.

RECENT CRANIOLOGICAL STUDIES.

DR. RUDOLF MARTIN, already familiar to Americanists by his somatologic writings on the natives of Tierra del Fuego, has lately published in the quarterly journal of the *Naturforschende Gesellschaft*, of Zürich, an article on 'Old Patagonian Skulls.' The crania, twelve in number, were obtained from the left bank of the Rio Negro, about fifty kilometers above its mouth. He subjects them to a searching scrutiny and an analysis of their dimensions. They do not seem to show marked traits of degeneration. In form they are brachycephalic and prognathic, with prominent cheek bones. Two full-plate illustrations

and several in the text accompany the paper.

In the proceedings of the Berlin Anthropological Society for January last, Dr. Felix von Luschan has a contribution in which he describes three trepanned skulls from Tenerife, and refers to seven other examples from the same locality. The operation seems to have been generally successful. Some others present cicatrices, which appear to have been from wounds intentionally inflicted for ceremonial purposes. He also gives examples of defective tympanic bones in artificially deformed skulls from Peru.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE BRITISH ASSOCIATION.

THE British Association for the Advancement of Science, whose preeminence is borne witness to by the fact that it is always called simply 'The British Association' by British newspapers and the general public, is meeting at Liverpool during the present week. Since its first meeting in 1831, the Association has been an important factor in the progress of science in Great Britain and has set an example which has been followed by the nations showing the greatest scientific activity. It has to a considerable extent fulfilled its objects: "To give a stronger impulse and a more systematic direction to scientific inquiry, to promote the intercourse of those who cultivate science in different parts of the British Empire, with one another and with foreign philosophers, to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which impede its progress."

The Liverpool meeting, presided over by Sir Joseph Lister, also president of the Royal Society and by common consent one of the greatest men of science now living, with men such as Prof. J. J. Thomson to preside over its sections, with a strong local committee, in a city offering many attractions, is sure to promote the objects of the Association and surpass in importance the similar meetings in other countries. Yet it is probable that the meeting will be less influential than that held in the same place 26 years ago, when, with an attendance of 2,878, Huxley as president gave his remarkable address on 'Biogenesis,' and the presidents of the sections included Clerk-Maxwell, Sir Henry Roscoe, Rollerson, Murchison and Jevons.

The British Association does not escape the criticism usual in such cases; it has been said that it has no further *raison d'être*, and even that it is only being kept alive long enough to make presidents of certain men who want this honor. Yet it is probable that such an association has never been more useful or more needed. The men active twenty-six years ago have since become more famous and are mostly no longer living. But new men have come and new problems. The advance of science has never before been so steady and so widespread. There has never been a time when it was more advantageous for men of science to meet together, and use their collective influence for the common good.

THE PASTEUR MEMORIAL.

WE have on several occasions called attention to the monument in memory of Pasteur, to be erected in Paris. There is a strong committee, consisting of a number of the leading men of science in France and having as honorary members the President of the Republic and his cabinet, together with about one hundred and sixty of the most prominent officials, scientists and other distinguished citizens of France. It has been wisely decided to make the memorial international and a committee for the United States has been organized, consisting of Dr. D. E. Salmon, Chairman, Dr. E. A. de Schweinitz, Secretary, Dr. Geo. M. Sternberg, Dr. J. Rufus Tryon, Dr. Walter Wyman, Prof. S. F. Emmons, Prof. Lester F. Ward, Dr. Wm. B. French, Hon. Gardiner G. Hubbard, Mr. C. L. Marlatt, and Dr. Ch. Wardell Stiles. Dr. G. Brown Goode, active in so many useful works, was treasurer of the committee.

The committee has devoted much attention to the subject and has corresponded with many societies and individuals. It prefers to have

each organization appoint one of its members as an associate member of this committee with authorization to collect and forward the subscriptions. No one is expected to subscribe an amount so large that it will detract in the least from the pleasure of giving. A large number of small subscriptions freely contributed and showing the popular appreciation of this eminent Frenchman is what is most desired.

GENERAL.

THE American Society of Naturalists meets at Boston December 29th and 30th, 1896. The American Physiological Society, The American Morphological Society and The American Psychological Association have signified their intenion to hold their meetings at the same time and place. The program of the Naturalists' meeting will be announced at an early date.

THE International Zoological Congress will hold its next meeting in September 1898, in Cambridge, England, which is also the place and time of meeting of the International Physiological Congress. The International Psychological Congress will next meet in Paris in 1900, as will also the International Congress of Electricians.

WE are compelled this week to record a number of deaths among foreign men of science. Prof. Luigi Palmieri, the well-known meteorologist, has died at the age of eighty-nine years. He had been professor in the University of Naples since 1847, and was director of the Meterological Observatory of Mt. Vesuvius. Dr. Philipp Ludwig Ritter von Seidel, professor of mathematics in the University of Munich, died on August 13th at the age of seventy-five years. M. Carrière, an officer of the Jardin des Plantes, Paris, and the author of important contributions to the subject of variation in plants, died on August 18 at the age of seventy-nine years. The deaths are also announced of Ferdinand von Herder, formerly librarian of the botanic garden of St. Petersburg; of Cajétan de Kraszewski, a Polish astronomer and meteorologist; of Dr. Joh. Jak. Egli, professor of geography in the University of Zurich, and of Dr. Minnegerode, professor of mathematics in the University of Greifswald.

ACCORDING to the daily papers, a despatch from Odessa, Russia, states that M. Kildischowsky, an electrician, has discovered an improvement in the telephone, by the use of which distance has no effect upon the hearing. In an experiment between Moscow and Rostoff, a distance of 890 miles, talking, music and singing were heard with perfect distinctness. For the purpose of this experiment an ordinary telegraph wire was used. M. Kildischowsky will go to London to experiment with his improvement on the Atlantic cables between London and New York.

A SPECIAL laboratory for the study of diphtheria under the direction of Prof. Flügge has been opened in connection with the laboratory of hygiene in the University of Breslau.

THE Electrical Standardizing Testing and Training Institution of London, has made arrangements to give instruction in medical electricity, including applications of the Röntgen rays to surgery.

M. BIJOURDAN proposes to determine, under the direction of M. Janssen, the force of gravity on Mt. Blanc. An observer at Chamonix in telegraphic communication with the observatory at Paris, will send the times to the summit of Mt. Blanc by an optical system.

THE Leander McCormick Observatory of the University of Virginia, under the direction of Prof. Ormond Stone, has been engaged in the observation of the relative positions of the satellites of Saturn and valuable results have already been secured, from which it is hoped to obtain greatly improved orbits of those bodies.

THE autumn meeting of the Iron and Steel Institution of Great Britain, was held this year at Bilboa, Spain, beginning on August 31st. There were special reasons for meeting at this place, as for the last 20 years the north of Spain has supplied the blast furnaces of South Wales, Middlesbrough, Scotland, and to a less extent of other districts, with the greater part of their raw materials, apart from a certain quantity of local ores. The exports of iron ores from Bilboa during the current year are estimated at over 6,000,000 tons, but the supply now threatens to become exhausted, and there is much competition among the iron and steel

workers in Great Britain, France and Germany to secure control of what remains.

A DESPATCH to the daily papers from Portland, Ore., states that Mt. Hood has been in eruption. A party of twenty-one persons narrowly escaped being buried under an avalanche of rock and ashes.

A MONUMENT in memory of the mineralogist and poet, Franz von Kobel, was unveiled in Munich on July 19th. Franz von Kobel, who died in 1882, was for more than 50 years professor of mineralogy in the University of Munich and made many contributions to all departments of the science, and was also well known among the people for his poems in the Bavarian dialects.

A COMMITTEE to forward the erection of the Pasteur monument has been formed in Bavaria, consisting of Professors v. Pettenkofer, v. Ziemssen and Buchner.

Electricity notes that it is proposed to erect a monument over the grave of Georg Simon Ohm. Subscriptions will be received by the Königliche Filiabank, Munich.

THE fiftieth anniversary of the Smithsonian Institution is made the occasion of an extended article on its history and present condition by Dr. Max Voretzsch in *Die Natur* for August 30th.

THE catalogue issued during August by Bernard Quaritch, 15 Piccadilly, London, offers for sale a large number of scientific books, some of them of great value, such as complete sets of the *American Journal of Science* (£110), *Curtis's Botanical Magazine* (£148), *Monthly Notices of the Royal Astronomical Society* (£24), etc.

THE Macmillan Co. announce the following new volumes in the Rural Science Series edited by Prof. Bailey, of Cornell University: 'The Apple,' by L. H. Bailey; nearly ready. 'Fertility of the Land,' by I. P. Roberts, of Cornell University; ready in October. 'Physiology of Plants,' by J. C. Arthur, of Purdue University. 'Grasses,' by W. H. Brewer, of Yale University. 'Bush Fruits,' by F. W. Card, of the University of Nebraska. 'Plant Diseases,' by B. T. Galloway, E. F. Smith and A. F. Woods, of the U. S. Department of Agriculture. 'Seeds and Seed Growing,' by G. H. Hicks, of the U. S. Department of Agriculture. 'Leguminous Plants,' by E. H. Hilgard, of the University of California. 'Feeding of Animals,' by W. H. Jordan, of Maine Experiment Station. 'Irrigation,' by F. H. King, of the University of Wisconsin. 'Milk and its Products,' by H. H. Wing, of Cornell University.

AMONG D. Appleton & Co.'s September publications are 'What is Electricity?' by Prof. John Trowbridge, of Harvard University, a new volume in the International Scientific Series, and 'Alterations in Personality,' by M. Alfred Binet, with an introduction by Prof. J. Mark Baldwin.

THE Royal Society of Sciences, of Saxony, celebrated the fiftieth anniversary of its foundation on July 1st. The King of Saxony was present and an address was made by the eminent chemist, Prof. Wislicenus.

A COMPANY has been organized at Little Rock, Ark., with a view to using horseless carriages in the place of, or in opposition to, the street cars. A franchise has been requested and a proposition made to the City Council to pay 5 per cent. of the net receipts to the city.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Columbian University, Washington, has established a veterinary department, the faculty of which will include D. E. Salmon, who will be dean of the faculty, professor of sanitary medicine, control and eradication of contagious diseases and inspection of meats; John Lockwood, professor of theory and practice of medicine and surgery; William P. Carr, professor of general physiology; E. A. de Schweinitz, professor of chemistry; Charles F. Dawson, professor of physiology and pathology; A. M. Farrington, professor of obstetrics and zootechnics; D. E. Buckingham, professor of materia medica and therapeutics; James Carroll, professor of pathology and bacteriology; Cecil French, professor of canine pathololy; Albert Hassall, professor of parasitology. W. S. Washburn, professor of histology; Charles F. Hadfield, demonstrator of anatomy; C. Wardell Stiles, lecturer on zoology and Edwin Willitts, lecturer on medical jurisprudence.

A DEPARTMENT of biology in the graduate school of Georgetown University has been organized and placed under the direction of Dr. C. W. Stiles. The instructors and lecturers include Merton B. Waite, professor of botany; Sylvester D. Judd, instructor in biology; Dr. Frank Baker, lecturer on anthropology; Dr. Leland O. Howard, lecturer on insects; Dr. T. S. Palmer, lecturer on mammals; Prof. James E. Benedict, lecturer on marine invertebrates; Prof. Charles T. Simpson, lecturer on mollusks: Prof. Chas. W. Richmond, lecturer on birds; Prof. Henry Olds, lecturer on songs of birds, and Prof. W. P. Hay, lecturer on amphibia and reptiles.

A COMMITTEE of the graduate students of Bryn Mawr College has in preparation a handbook of courses open to women in foreign universities. It will contain a complete list of professors and lecturers at all colleges and universities where women are admitted; together with the subjects in which lectures are given, the entrance requirements, fees, beginnings and endings of terms, degrees granted to women, and other particulars of importance. In this connection it may be noted that the University of Durham will not only open the degree of B. A. to women, but will also throw open some eight scholarships and exhibitions, varying in value from £20 to £70 a year, besides various university prizes, and that Bonn has followed the example of several other German universities and now admits to the lectures women who can show proper preparation and secure the permission of the lecturer.

THE Pope gave permission last year for laymen to attend the English universities, and the Duke of Norfolk has purchased for $65,000 a site on which it is proposed to erect a Roman Catholic college at Oxford.

PROF. W. L. AMES, who has been for some years at the head of the Department of Drawing and Designing at the Rose Polytechnic Institute, has recently resigned to accept a similar position in the Worcester Polytechnic Institute.

MISS PARKER, a daughter of Prof. W. A. Parker, of the University of Alabama, has been appointed professor of natural sciences in the Georgia Industrial College at Milledgeville.

THE correspondent of the N. Y. *Evening Post* from Colgate University writes that Mr. J. Fay Smith, a graduate student of Cornell University, will take charge of the department of physics until January, when Prof. Nichols, who has been for two and a half years at the University in Berlin, will return. Mr. H. E. Nims has charge of the department of chemistry during Prof. McGregory's absence in Göttingen, where he will remain until January.

THE following appointments are announced in the *Naturwissenschaftliche Rundschau:* Dr. Lobry de Bruyn has been made full professor of general and pharmaceutical chemistry in the University of Amsterdam; Dr. W. H. Julius has been promoted to a full professorship of physics in the University of Utrecht; Dr. Wilhelm Fleischmann, of the University of Königsberg, has been made director of the agricultural institution at the University of Göttingen, and Dr. Emil Erlenmeyer has been appointed assistant professor of chemistry in the University of Strasburg.

SCIENTIFIC LITERATURE.

Ice Work Present and Past. T. G. BONNEY, D. Sc., LL.D., F.R.S., F.S.A., F.G.S. International Scientific Series. D. Appleton & Company. 1896.*

In the introduction it is intimated that this work is written primarily for the student. There are many passages, however, which indicate that amateurs, teachers, general geologists, and even glacial specialists, were in the author's mind as he wrote. It is not, on the one hand, a strictly popular work adapted to those who are quite unfamiliar with the subject; nor is it, on the other, a thoroughgoing treatise especially serviceable to glacialists. It is not clear that the author has been altogether successful in the difficult task of adapting his method and matter to the intermediate class. A doubt arises whether he has been explicit and illustrative enough upon the glacial fundamentals, on the one hand, and, on the other, whether he has not entered so much into detail in the treatment of certain local phenomena, es-

* Reviewed by request.

pecially British phenomena, as possibly to be tedious to this class.

The author proposes to himself the avoidance of the special advocacy of particular interpretations, which he regards as the peculiar fault of most treatises on the subject. He professes to be a judge and not a lawyer, and in harmony with this there is an obvious effort throughout to be judicial in his attitude. The implication of partiality on the part of most authors will hardly be accepted by the admirers of 'The Great Ice Age' or of 'Handbuch der Gletscherkunde,' and the author's assumption of the functions of a judge, meting out the unbiased truth where specialists have failed, is embarrassed by the absence of that prolonged and profound study which is usually regarded as the prerequisite of the judicial office. Dr. Bonney has written chiefly on petrological subjects during the past twenty years, although previous to this he had studied and written considerably on glaciers. It follows from this long devotion to a fascinating specialty that his familiarity with the literature of glaciology is not altogether intimate, and this finds repeated expression throughout the book. Much of the material is taken from compilations rather than from original sources and errors of fact and of reference are not infrequent.

The work has an excellent tripartite plan, proceeding from the existing evidence of ice work in alpine glaciers and arctic and antarctic ice sheets (Part I.), to the traces of the glacial epoch (Part II.), and thence to theoretical questions (Part III.). This logical scheme is not closely adhered to however, and doubtless wisely, in the main. The illustrations in the first part are chiefly taken from the glacial drift of the past, while there are no illustrations of existing glaciers. In Part II. hypotheses and interpretations form a notable portion of the discussion.

The relation of lake basins to glaciers receives foremost attention under the head of Traces of the Glacial Epoch. The author's bias is obviously unfavorable to much glacial excavation, indeed he had previously announced the conclusion, based on observations near the ends of certain alpine glaciers, that ice 'has practically no power to excavate.' In the discussion of the lakes and elsewhere he manifests a hospitality to theories involving submergence. Eskers are treated at a reasonable length and are fairly described. Their origin is left more indeterminate than needful. It may be accepted as demonstrated that they are the direct product of glacial drainage. The only legitimate questions remaining undecided relate to details of special position and of relations to the ice. The discussion of drumlins is brief and unsatisfactory. The great phenomena of the till sheets and of the marginal moraines are almost ignored in the treatment of the traces of the glacial epoch, though moraines of the alpine type are frequently referred to in the discussion of the present glaciers.

Ice work in Great Britain is discussed with much elaborateness, which will doubtless make the work acceptable to the subjects of the Queen, but will seem to American students, in view of the limitation of the great deposits of this continent to ten pages, somewhat disproportionate. In the discussion of the American formations the selection of matter is not all that could be desired. There is no comprehensive sketch of the great features of this greatest of all glaciated regions. The map given is old and borrowed from a popular work, and fails to represent the latest delineations, much less the latest classifications. The map of the imaginary Lake Ohio has no place in such a work. The 1,700-foot beach lines of Spencer are cited as though unquestioned, though we think their author would not now insist upon the correctness of his identification.

The third part opens with an interesting and valuable discussion of the temperature of the glacial epoch, in which it is maintained that a very moderate fall of the average temperature would suffice for the glaciation that occurred. In discussing the probable causes of the glacial epoch, Dr. Bonney points out at length the difficulties that attach to all current hypotheses, and concludes that a complete solution of the problem is as yet undetermined, and in this we think he is altogether correct. In the treatment of the number of glacial epochs, the discussion turns, not upon the number of subdivisions of the Pleistocene glaciation (a subject much discussed in recent years), but on the number of

cold periods in the whole history of the globe. He sketches the supposed evidences of pre-Pleistocene glaciation, and concludes that only in the late Carboniferous or early Permian period does the testimony for the prevalence of a low temperature over a large part of the globe seem at present satisfactory. He concludes that a glacial epoch is a rare episode in the history of the earth. In the discussion of general principles of interpretation the treatment is rather academic, as must needs be when undertaken by a specialist in petrology. The interpretation of glacial phenomena equals, if it does not transcend, in difficulty, that of most other classes of geological phenomena, and the true principles of interpretation are not likely to be determined except by long and critical trial in the field.

The work is very well written but very poorly illustrated.

T. C. CHAMBERLIN.

UNIVERSITY OF CHICAGO.

Iowa Geological Survey, Volume V., Annual Report for 1895. SAMUEL CALVIN, State Geologist; H. F. BAIN, Assistant State Geologist. pp. 452, 7 maps, pls. 14, 72 figs. Des Moines. 1896.

The fifth volume of the publications of the Iowa Geological Survey presents the same excellent typographical appearance which characterizes the former volumes. These publications, which have appeared in rapid succession, indicate continued great activity on part of those engaged in the work. The title annual report is rather misleading, for the subject-matter contains nothing that is of temporary character except the administrative part which consists of a few pages only. As in the previous volumes of this survey there is carried out the highly commendable policy established at the beginning, of eliminating all matter from the reports that is of a preliminary nature, and of publishing only material that has been carefully digested and classified. In this way the total amount of matter published is not nearly so great as it otherwise would be. With great advantage all work of preliminary character which so often goes to make up the large bulk of geological publications is omitted. Thus, only the work in its ultimate form is made public. The set of volumes becomes the 'final' series, and only a single class of publications is issued.

The volume is devoted to areal geology, and six counties are carefully and fully described. One of these, Jones county, is by Prof. S. Calvin, State Geologist. Three, by Prof. H. F. Bain, Assistant State Geologist, are on Washington, Woodbury and Appanoose counties. One, by Dr. S. W. Beyer, is on Boone county; and another on Warren county is by Prof. J. L. Tilton.

In all the reports the economic aspects of the mineral resources are placed prominently in the foreground. Yet the purely geological phases of the various questions are given full consideration, and in a thoroughly scientific manner.

CHARLES R. KEYES.

NEW BOOKS.

What is Electricity? JOHN TROWBRIDGE. New York, D. Appleton & Co. 1896. Pp. vi+315.

Physics for University Students. Part I., Mechanics, Sound and Light. Part II., Heat, Electricity and Magnetism. HENRY S. CARHART. Boston, Allyn & Bacon. 1895, 1896. Pp. iv+344 and 446.

Electrical Measurements. HENRY S. CARHART and GEORGE W. PATTERSON, JR. Boston, Allyn & Bacon. 1895. Pp. v+344.

The History of Mankind. FRIEDRICH RATZEL. Translated from the second German Edition by A. J. Butler, with introduction by E. B. Tylor. Vol. I. London and New York, Macmillan & Co., Limited. 1896. Pp. xxiv+486. $4.00.

Navigation and Nautical Astronomy. F. C. STEBBING. London & New York, Macmillan & Co., Ltd. 1896. Pp. vii+328. $2.75.

Astronomical, Magnetic and Meteorological Observations made during the year 1890 at the U. S. Naval Observatory. CAPT. FREDERICK V. MCNAIR. Washington, Government Printing Office. 1895. Pp. lxiii+420.

Società degli Alpiniste Tridentini XIX. Annuario 1895. Rovereto, Tipografia Roveretana. 1896. Pp. 568.